132907

Technical Report 769

ORI

(NASA-CR-132907) STUDY OF DATA COLLECTION PLATFORM CONCEPTS: DATA COLLECTION SYSTEM USER REQUIREMENTS Final Report (Operations Research, Inc.) ~~190~~ p HC $12.50 CSCL 09F G3/07

N74-16892

Unclas 30443

STUDY OF DATA COLLECTION PLATFORM CONCEPTS

Final Report

Data Collection System User Requirements

April 1973

Prepared under Contract No. NAS5-21632
for Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, Maryland 20771

Operations Research, Inc. A LEASCO Company

OPERATIONS RESEARCH, Inc.

SILVER SPRING, MARYLAND

STUDY OF DATA COLLECTION PLATFORM CONCEPTS

Final Report

Data Collection System User Requirements

April 1973

Prepared under Contract No. NAS5-21632
for Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, Maryland 20771

I

TABLE OF CONTENTS

LIST OF FIGURES

PRECEDING PAGE BLANK NOT FILMED

LIST OF TABLES

I. INTRODUCTION AND SUMMARY

This report is in response to Contract NAS5-21632, Study of Data Collection Platform Concepts, and is designated as Item 7, Article V of the contract.

The overall purpose of the Data Collection User Survey was to provide real world data on user requirements. That is, the intent was to assess data collection system user requirements by questioning actual potential users rather than speculating on requirements. The end results of the survey are baseline requirements models for both a data collection platform and a data collection system. These models, given in section IV, were derived from the survey results given in Section III. The real value of these models lies in the fact that they are based on actual user requirements as delineated in the survey questionnaires.

The requirements models and other requirements information contained in Sections III and IV can serve several useful purposes. First of all, the models as they stand can provide a starting point for the design of data collection systems. Further, the survey results are presented in such away as to aid in the inevitable process of narrowing requirements to meet economic constraints. No single system can satisfy all of the potential users all of the time. Decisions then have to be made regarding the relative importance of various requirements. The survey data as presented in Section III provides a quantitative measure of relative importance through the specification of the relative number of users and relative number of platforms associated with a particular requirement. One could conceivably rule out certain requirements/performance parameters using this user demand as a basis if no other criteria for priorities are used. Next, the survey data revealed new technology requirements. Specifically some users desire data collection platforms of small size and light weight. These sizes and weights are beyond the present state of the art. Also, the survey provided a wealth of information on the nature and constituency of the data collection user community as well as information on user applications for data collection systems. Finally, the data sheds light on the Generalized Platform Concept. That is, the diversity of user requirements shown in the data indicates the difficulty that can be anticipated in attempting to implement such a concept.

II. DISCUSSION OF THE SURVEY

2.1 GENERAL INFORMATION

The survey of data collection system users was carried out in two stages using two separate questionnaires. The initial questionnaire was mailed using a listing of known and potential data collection users (reference 1). Of the 838 potential users on this list, 259 responded. Of those who responded, 178 stated a willingness to answer a more detailed questionnaire. Upon receipt and review of the initial questionnaires, a more detailed questionnaire was derived. This more detailed questionnaire was mailed to 262 organizations. These included the 178 respondees to the first questionnaire who indicated a willingness to answer a more detailed questionnaire and 74 respondees to the first questionnaire who did not respond to the question concerning their willingness to answer a more detailed questionnaire. Finally, an additional 10 organizations were added to the list by referral.

The data used for analyzing the requirements was taken from 259 initial questionnaires and 62 final (more detailed questionnaires). Copies of these questionnaires are given in reference 1.

2.2 DISCUSSION OF RESPONDEE POPULATION

The survey data used in the analysis and synthesis of the requirements which follows comes from a variety of types of organizations. Table 2.1 summarizes the organizational affiliations of the respondees to the second questionnaire as an example. Also since the U.S. Government is a major user of data collection systems, Table 2.2 is given to show specific government affiliations.

It will be seen in the sections to follow that these users have a wide variety of applications for data collection systems.

TABLE 2.1

MAJOR SUBDIVISION OF ORGANIZATIONS

Organizations	Number of* Replies	Number of Platforms
Universities	26,33	701
U.S. Government	19,27	9,675
State and Local Government	1	-
Private Industry	3,5	178
Private Research Institutions	8,9	711
Totals	56,75	11,265

*The two numbers given in this column indicate the number of respondees who indicated the number platforms (left) and the total number of replies.

TABLE 2.2

U.S. GOVERNMENT ORGANIZATION LISTING

Organization	Number of* Replies	Number of Platforms
• DEPARTMENT OF COMMERCE		
• NOAA: -National Ocean Survey	1,3	30
-National Environmental Satellite Service	1	-
-AOML Physics Oceanography Lab	1,1	300
-National Data Buoy Center	1,1	210
-Pacific Marine Fisheries Commission	1	-
-National Climatic Center	1	-
-National Marine Fisheries Service	2,4	22
• National Bureau of Standards		
-Center for Computer Science and Technology	1	-
• DEPARTMENT OF TRANSPORTATION		
• U.S. Coast Guard:		
-Applied Science Div.	1,1	6
• DEPARTMENT OF INTERIOR		
• Bureau of Reclamation	1,1	100
• Bureau of Outdoor Recreation	1	-
• Bonneville Power Administration	1,1	3
• Coastal Engineering Research Center	1	-

*The two numbers given in this column indicate the number of respondees who indicated the number platforms (left) and the total number of replies.

TABLE 2.2 (Cont)

Organization	Number of* Replies	Number of Platforms
• DEPARTMENT OF AGRICULTURE		
• U.S. Forest Service:		
-Dir. Emergency Operations	1,1	900
-Remote Sensing of Forest Environment	1,1	4
• Soil Conservation Service	1	-
• DEPARTMENT OF DEFENSE		
• Army:		
-New England Div, Corps of Engineers	1,1	80
-U.S. Army Atmospheric Sciences Lab	1,1	5,000
-USAE Waterways Experiment Station	1,1	12
-Civil Works Directorate, Remote Sensing Research	1,1	3,000
-U.S. Cold Regions Research and Engineering Lab	1,1	8
• Navy:		
-NRL, Remote Sensing Oceanography Project	1	-

* The two numbers given in this column indicate the number of respondees who indicated the number of platforms (left) and the total number of replies.

III. SURVEY RESULTS

3.1 INTRODUCTION

In this section, the results of the NASA data collection system user survey are presented. It should be emphasized that this section presents the results. In Section IV, these results are interpreted and a baseline requirements model is synthesized.

The data is presented in two ways. The first tabulation of the data is by Area of Interest (or User Application). That is, if the respondee indicated an interest in a particular area (e.g., Meteorology, Ecology, etc.) his data was tabulated under that heading. The data is organized according to platform data and system data. This tabulation allows for the derivation of requirements for specific areas of interest. This is useful both in designing specialized data collection systems and in further understanding of the requirements in general. Second, for each question, the number of data collection platforms and number of responses corresponding to each possible answer to the question are presented. This data is presented in graphical form (see Section 3.3). In this way, user demand for various platform and system parameters may be assessed directly. In fact, the set of graphs given in Section 3.3 can be viewed as one form of a baseline requirements model.

3.2 APPLICATIONS DATA

In this section of the report, platform and system data are tabulated for several scientific areas of interest. In the initial questionnaire, the users were asked to identify such areas of interest. The areas of interest and definitions used were as follows:

- Agriculture: The science or art of cultivating the soil, producing crops, and raising livestock
- Ecology: A branch of science concerned with the interrelationship of organisms and their environments. The totality or pattern of relations between organisms and their environment.
- Environmental Quality: Study of the total earth environment as it relates to the quality of human life.
- Forestry: The science of developing, caring for, or cultivating forests. The management of growing timber.
- Geology: Science that deals with the history of the earth and its life especially as recorded in rocks. Study of the solid matter of a celestial body.
- Geography: A science that deals with the earth and its life; especially the description of land, sea, air,and the distribution of plant and animal life including man and his industries.
- Hydrology: A science dealing with the properties, distribution and circulation of water on the surface of the land, in the soil and underlying rocks, and in the atmosphere.
- Meteorology: Science that deals with the atmosphere and its phenomena and especially with weather and weather forecasting. The atmospheric phenomena and weather of a region.
- Climatology: Science that deals with climates and their phenomena.
- Oceanography: A science that deals with the ocean and its phenomena.
- Fisheries: Studies of the act, process, occupation or season of taking fish or other sea products. The technology of fishery.
- Engineering: Study of the engineering aspects of satellite data collection systems.

- Geodesy: Branch of applied mathematics that determines the exact positions of points and the figures and areas of large portions of the earth's surface, the shape and size of the earth, and the variations of terrestrial gravity and magnetism.
- Photogrammetry: Science of making reliable measurements by the use of USV. aerial photographs in surveying and map making.
- Wild Life and Range Management
- Information/Data Management
- Ocean Mining
- Micrometeorology: The study of climatic conditions in very small areas.
- Permafrost: A permanently frozen layer of variable depth below the earth's surface in frigid regions.
- Cartography: Science or art of making maps.
- Zoology: Science that deals with animals and is the branch of biology concerned with the animal kingdom and its members as individuals and classes and with animal life. The properties and vital phenomena exhibited by an animal, animal type, or group.
- Planetary Exploration

Within the general areas of interest, the user had an interest in specific experiments or applications. One can also take the view that the user had specific experiments in mind which apply to several areas of interest using the previously listed definitions of these areas as a guide. The user's areas of interest and specific experiments are given in Tables 3.1 through 3.7.

As shown in these tables, most users checked more than one area of interest. Also, in some cases, more than one specific experiment/application was given. Upon comparing the experiments given with the areas of interest indicated it becomes apparent, in some cases, that the specific experiments do not apply to all the areas of interest indicated by the user. The net result of this situation is that the users data may or may not apply to all the areas of interest which he indicated. This fact was accounted for in the tabulations to follow. It is of interest to note that 18 of the 62 users did not indicate a specific experiment.

Using Tables 3.1 through 3.7, a breakdown of specific experiments for each area of interest is given in Tables 3.8 through 3.16 Keep in mind that this is information directly from the questionnaire with a minimum of interpretation. In the tables, the dash beside some of the ID numbers indicates that the user checked the area of interest but did not give a specific experiment in the area.

3.2.1 Platform Data

In this section, the platform data is tabulated for each area of interest previously identified. In the tables, the user ID is given along with the data associated with his platform requirements. There is a pair of tables for each area of interest. These tables can be viewed as one form of the platform requirements for each area of interest. A more specific requirement will be considered in later sections of this report.

3.2.1.1 Agricultural Platform Data

The platform data considered applicable to Agriculture is given in Tables 3.17 and 3.18. Before categorizing the data under Agriculture, the data for each user was reviewed to see if it was applicable. This was done even though the user had indicated Agriculture. The only item found that might be inconsistent with Agriculture was the use of buoy-type platforms by one of the users. It is evident from an examination of the data that the platform requirements are mixed with the exception that most of the platforms are of the Fixed type which one would anticipate for Agriculture applications.

The diversity of interest by each user was considered to be of interest and can indeed be used for later interpretation purposes. Table 3.19 summarizes this diversity by tabulating the number of other areas of interest indicated by the user (N_O), the number of specific experiments/applications indicated by the user (N_E) and the number of platforms (N_P).

3.2.1.2 Ecological Platform Data

The platform data considered applicable to Ecology is given in Tables 3.20 and 3.21. The term Ecology covers a myriad of subjects and applications. This is verified by the large number of users who indicated Ecology as an area of interest. As with the other areas, the data was examined for applicability to Ecological applications even though the user had indicated Ecology as an area of interest. No inconsistencies were found. It is evident from examination of the data that the platform requirements are mixed.

The diversity of Ecology users is summarized in Table 3.22.

TABLE 3.19

AGRICULTURAL USER DIVERSITY

ID	N_P	N_O	N_E
33	100	5	3
50	5	2	0
71	1	7	1
94	0	6	2
97	10	3	0
105	8	3	2
112	5	2	0
114	10	3	0
125	2	2	1
132	4	3	0
133	3	1	2
154	18	4	0
236	5	2	1
243	10	7	1
	181		

TABLE 3.22

ECOLOGICAL USER DIVERSITY

ID	N_P	N_O	N_E
4	6	4	3
17	245	5	1
19	0	3	1
30	30	5	0
31	900	4	5
32	3,000	5	1
33	100	5	3
38	12	2	3
57	20	3	0
63	0	1	1
71	1	7	1
73	0	2	1
91	10	4	0
94	0	6	2
95	12	5	2
97	10	3	0
101	8	4	1
105	8	3	2
114	10	3	0
118	25	1	1
132	4	3	0
136	50	4	2
140	5	3	0
146	300	3	5
154	18	4	0
170	31	1	1
193	5	3	0
236	5	2	1
242	0	1	2
243	10	7	1
	4,825		

3.2.1.3 Environmental Quality Platform Data

The platform data considered applicable to Environmental Quality is given in Tables 3.23 and 3.24. As with Ecology, Environmental Quality is a rather general (and popular term) and as one would expect, a large number of users indicated Environmental Quality as an area of interest. As with the other areas of interest, the data was examined for applicability to Environmental Quality applications even though the user had indicated Environmental Quality as an area of interest. No inconsistancies were found. It is evident from examining the data that the platform requirements are mixed.

The diversity of Environmental Quality users is summarized in Table 3.25.

3.2.1.4 Forestry Platform Data

The platform data considered applicable to Forestry is given in Tables 3.26 and 3.27. As with the other areas of interest, the data was examined for its applicability to Forestry even though the user indicated Forestry as an area of interest. Some of the data for users 95 and 101 appears to be inconsistent with Forestry. Also some users indicated Buoy type platforms which doesn't seem to fit Forestry. Thus for the requirements models to be derived the inconsistent data for 95 and 101 should not be used and Buoy type platforms will be considered questionable. It is evident from the data that the platform requirement for Forestry is mixed.

The diversity of Forestry users is summarized in Table 3.28.

3.2.1.5 Geology Platform Data

The platform data considered applicable to Geology is given in Tables 3.29 and 3.30. As with the other areas of interest, the data was examined for its applicability to Geology. A significant portion of the data appears to be inconsistent with Geological applications. That data is marked by an asterisk in the tables. The inconsistencies lie in the types of platform and environmental conditions. These inconsistencies should be accounted for in requirements model to be derived for Geology. In any event the platform requirements for Geology are mixed.

The diversity of Geology users is summarized in Table 3.31.

TABLE 3.25

ENVIRONMENTAL QUALITY USER DIVERSITY

ID	N_P	N_O	N_E
4	6	4	3
17	245	5	1
19	0	3	1
23	30	3	1
30	30	5	0
31	900	4	5
32	3,000	4	1
33	100	5	3
57	20	3	0
71	1	7	1
73	0	2	1
84	80	2	1
91	10	4	0
94	0	6	2
95	12	5	2
101	8	4	1
105	8	3	2
114	10	3	0
118	25	1	1
125	2	2	1
132	4	3	0
136	50	4	2
140	5	3	0
146	300	3	5
154	18	4	0
193	5	3	0
235	300	2	2
236	5	2	1
243	10	7	1
246	95	3	1
248	6	2	0
256	210	2	2
	5,505		

TABLE 3.28

FORESTRY USER DIVERSITY

ID	N_P	N_O	N_E
31	900	4	5
32	3,000	5	1
50	5	2	0
55	4	0	2
71	1	7	1
94	0	6	2
*95	12	5	2
*101	8	4	1
114	10	3	0
116	10	4	0
132	4	3	0
136	50	4	2
243	10	7	1
248	6	2	0
	4,045		

* Indicates part of data inconsistent with Forestry.

TABLE 3.31

GEOLOGY USER DIVERSITY

ID	N_P	N_O	N_E
17	245	5	1
30	30	5	0
32	3,000	5	1
33	100	5	3
71	1	7	1
91	10	4	0
94	0	6	2
95	12	5	2
112	5	2	0
116	10	4	0
125	2	2	1
140	5	3	0
154	18	4	0
193	5	3	0
243	10	7	1
	3,455		

3.2.1.6 Hydrology Platform Data

The platform data considered applicable to Hydrology is given in Tables 3.32 and 3.33. As with the other areas of interest, the data was examined for its applicability to Hydrology. None of the data appeared inconsistent with Hydrological applications. Examination of the data shows a mixed platform requirement for Hydrology.

The diversity of Hydrology users is summarized in Table 3. 34.

3. 2.1.7 Meteorology Platform Data

The platform data considered applicable to Meteorology is given in Tables 3.35 and 3.36. As with the other areas of interest, the data was examined for its applicability to Meteorology. None of the data appeared inconsistent with Meteorological applications. Examinations of the data shows a mixed platform requirement for Meteorology.

The diversity of Meteorology users is summarized in Table 3. 37.

TABLE 3.34

HYDROLOGY USER DIVERSITY

ID	N_P	N_O	N_E
17	245	5	1
30	30	5	0
31	900	4	5
32	3,000	5	2
33	100	5	3
34	3	1	1
50	5	2	0
57	20	3	0
71	1	7	1
73	0	2	1
84	80	2	1
91	10	4	0
94	0	6	2
95	12	5	2
97	10	3	0
101	8	4	1
112	5	2	0
116	10	4	0
124	*5,000	1	1
135	2	0	0
137	0	2	0
154	18	4	0
243	10	7	1
246	95	3	1
	4,564		

* User with 5,000 platforms. Based on his overall requirement (Tactical Meteorological Support for the Army) his platforms are excluded from the platform count; however, his requirements data is considered good.

TABLE 3.37

METEOROLOGY USER DIVERSITY

ID	N_P	N_O	N_E
4	6	4	3
17	245	5	1
24	90	1	1
30	30	5	0
31	900	4	5
33	100	5	3
34	3	1	1
64	25	1	2
66	30	1	5
71	1	7	1
84	80	2	1
94	0	6	2
97	10	3	0
116	10	4	0
124	*5,000	1	1
145	300	1	1
146	300	3	5
235	300	2	2
243	10	7	1
246	95	3	1
256	210	2	2
	2,745		

*User with 5,000 platforms. Based on his overall requirement, (Tactical Meteorological Support for the Army), his platforms are excluded from the platform count; however, his requirements data is considered good.

3.2.1.8 Oceanography Platform Data

The platform data considered applicable to Oceanography is given in Tables 3.38 and 3.39. As with the other areas of interest, the data was examined for its applicability to Oceanography. Data given by users 17, 140, and 243 appeared inconsistent with Oceanography. These inconsistencies should be accounted for when deriving a requirements model for Oceanography.

The diversity of Oceanography users is summarized in Table 3.40.

3.2.1.9 Platform Data for Other Areas of Interest

In the questionnaires, some of the users indicated several other areas of interest most of which are more specialized than the previous areas. All of these areas are characterized by a small response. That is the number of users varies between 1 and 4. The areas are Fisheries, Engineering, Geodesy, Photogrammetry, Wild Life and Range Management, Information/Data Management, Ocean Mining, Micrometeorology, Permafrost Studies, Carrography, Zoology, and Planetary Exploration.

The platform data for these other areas is given in Tables 3.41 through 3.44. As with the preceding areas of interest, the data was studied for consistency. No inconsistencies were found.

The user diversity for these other areas of interest is summarized in Table 3.45 .

3.2.1.10 Summary of Platform Data

The platform data given by the users has been presented as it relates to various areas of interest. This data can be used as a basis for deriving platform requirements models for each area of interest. During the process of deriving these models, a further examination of the data should be performed to verify its relevance to the areas of interest. This examination would include comparing the experiments/applications specified by the user with the areas of interest. Thus far the data has been taken at face value and obvious inconsistencies noted. The match (or mismatch) between experiments/applications and areas of interest would be the major factor for determining the applicability of the data to the area of interest. A further aid in determining applicability will be considering the platform data and system data together.

TABLE 3.40

OCEANOGRAPHY USER DIVERSITY

ID	N_P	N_O	N_E
4	6	4	3
17	245	5	1
19	0	3	1
21	9	1	1
23	30	3	1
24	90	1	1
30	30	5	0
32	3,000	5	2
57	20	3	0
64	25	1	2
66	30	1	5
71	1	7	1
80	144	1	3
91	10	4	0
104	3	0	0
137	0	2	0
140	5	3	0
145	300	1	1
146	300	3	5
153	0	1	1
156	15	1	3
160	16	0	1
193	5	3	0
243	10	7	1
246	95	3	1
250	7	0	1
256	210	2	2
	4,606		

TABLE 3.45

OTHER AREAS OF INTEREST USER DIVERSITY

ID	N_P	N_O	N_E
	--FISHERIES--		
4	6	4	3
19	0	3	1
153	0	1	1
156	15	1	3
	--ENGINEERING--		
9	0	0	1
137	0	2	0
235	300	2	2
261	0	0	1
	--GEODESY--		
23	30	3	1
	--PHOTOGRAMMETRY--		
23	30	3	1
248	6	2	0
	--WILD LIFE AND RANGE MANAGEMENT--		
38	12	2	3
136	50	4	2
242	0	1	2
	--INFORMATION/DATA MANAGEMENT--		
71	1	7	1
	--OCEAN MINING--		
80	144	1	3

TABLE 3.45 (Cont)

ID	N_P	N_O	N_E
	--MICROMETEOROLOGY--		
95	12	5	2
	--PERMAFROST STUDIES--		
101	8	4	1
	--CARTOGRAPHY--		
105	8	3	2
	--ZOOLOGY--		
170	31	1	1
	--PLANETARY EXPLORATION--		
235	300	2	2
	923		

3.2.2 System Data

In this section, the system data is tabulated for each area of interest previously identified. In the tables which follow, the user ID is given along with the questionnaire data relevant to his data collection system requirements.

In fact, these tables can be viewed as one form of the system requirements for each area of interest. A more specific requirement for each area of interest will be considered in later sections of this report.

The system data is given in Tables 3.46 through 3.55. Note that the user diversity for each area of interest was presented in Section 3.2.1 and will not be duplicated in this section.

An initial examination of the data without regard to the specific experiments/applications stated by each user reveals what appear on the surface to be inconsistencies. These inconsistencies are as follows:

- Agriculture: Some of the synoptic periods appear too small since most physical events in the field of agriculture occur slowly (e.g., plant growth, plant disease etc.). One would expect synoptic periods of 24 hours to be adequate.
- Forestry: Some of the geographic areas are oceans
- Geology: Some of the geographic areas are oceans
- Oceanography: Some of the geographic areas are land masses

Detailed requirements models should be derived which account for these inconsistencies. In the derivation of these requirements, the specific experiments/applications given by the users will be used to determine the applicability of the data to the area of interest.

TABLE 3.1

USER APPLICATION DATA

ID	Organization	Agriculture	Ecology	Environmental Quality	Forestry	Geology	Hydrology	Meteorology	Oceanography	Fishery Resource Identification, Assessment and Monitoring	Engineering	Sea Ice	Geodesy and Satellite Triangulation	Photogrammetry	Specific Experiments/Applications
4	Remote Sensing Program National Marine Fisheries Service		X	X				X	X	X					• Temperature, Salinity, O2 concentration in Gulf of Mexico • Air Temperature, Wind Velocity • Loop Current Study, Gulf of Mexico
9	University of Arizona Optical Science Ctr.										X				• Correcting Errors in Spectral signatures obtained from satellites due to atmospheric effects
17	Center for Short-Lived Phenomina Smithsonian Institute		X	X		X	X	X	X						• All short lived, natural, and unpredictable phenomina that occur anywhere on earth, such as: Volcanos, earthquakes, landslides oilspills, fish and bird kills, animal and insect colonization and migration bright fire balls, meteorite falls, and urgent archaeological and anthropological events
19	Fishery Technology, Technical Advisory Division, NMFS		X	X					X	X					• Behavioral Studies of Marine Animals; migration routes, etc.
21	Applied Science Division, USCG								X			X			• Presumably-tracking icebergs/ Sea Ice
23	National Ocean Survey, NOAA			X					X				X	X	• Great Lakes Survey: - Wind Speed and Direction, Air Temperature, Dew Point, Barametric Pressure, Water Temperature; Current Speed and Direction, Precipitation, Incident and Reflected Radiation, Evaporation
24	North Pacific Study Scripps Institute of Oceanography							X	X						• Long Range O/A climate prediction

TABLE 3.2

USER APPLICATION DATA

ID	Organization	Agriculture	Ecology	Environmental Quality	Forestry	Geology	Hydrology	Meteorology	Oceanography	Fishery Resource Identification, Assessment and Monitoring	Engineering	Sea Ice	Geodesy and Satellite Triangulation	Photogrammetry	Wild-Life Management	Specific Experiments/Applications
30	Gulf Universities Research Corp.		X	X		X	X	X	X							
31	Emergency Operations U.S. Forest Service		X	X	X		X	X								• Fire Weather Warning, Avalanche Warning, Water Supply Prediction, Snow Melt Forecasts, Flood Forecast: - Solar Radiation, Net Radiation, Dew Point Wind Temperature, Snow Density, Rainfall Rate
32	Army Engineers		X	X	X	X	X		X							• Program Management and Research - River Level Data, Temperature, Humidity, Wind Speed, Precipitation
33	Bureau of Reclamation, DOI	X	X	X		X	X	X								• Real Time Decision Making for Cloud Seeding Project and Avalanche Prediction and Historical Data for System Evaluation - Wind Speed and Direction, Temperature, Precipitation Accumulation, Generator Functions
34	Bonneville Power Administration						X	X								• Use of Satellite to transmit data for operation of an integrated hydroelectric/thermal-electric power station
38	University of Maine Wildlife Resources		X					X							X	• Development of winter severity levels for Deer Wintering Areas, Effects of environmental influence part-climate on deer productivity, Movement patterns between summer and winter ranges for deer - Hygrothermographs, Barographs, Anemometers, Solarmeter, Snow Stakes
50	Iowa State University	X			X		X									
55	Remote Sensing of Forest Environment U.S. Forest Service				X											• Monitoring Forest Stress to identify earliest possible time for airborne (spaceborne) Detection of Stress by Remote Sensing • Monitoring Target(s) irradiance as an aide to identifying vegetation and land use types and change on remote sensing imagery - Biographical and Physiological sensors

TABLE 3.3

USER APPLICATION DATA

ID	ORGANIZATION	Agriculture	Ecology	Environmental Quality	Forestry	Geology	Hydrology	Meteorology	Oceanography	Information/ Data Management	Ocean Mining	Specific Experiments/Applications
57	Univ. of Iowa Institute of Hydrological Research		X	X			X		X			
63	Oceanic Inst. Makapuu Oceanic Center		X						X			• Moses: Ground truth station for spaceborne sensors, also use satellite to transmit MOSES data to an EDP center for near realtime processing and feedback and assistance in precise location and tracking of Moses when it is free drifting.
64	Applied Phys Lab Univ. of Washington							X	X			• Experimental platform for gathering environmental data Ultimately for weather and ice prediction service - Atmospheric Pressure Air Temperature, Wind Speed, Platform Temperature, Battery Voltage
66	Project AIDJEX							X	X			• Arctic Research-Prediction of Natural processes such as weather and Ice Condition • Feasibility, calculation of geostrophic Wind, System Longevity. Geostrophic Wind vs ice drift forecasting - Barometric Pressure,
71	Batelle Columbus Laboratories	X	X	X	X	X	X	X		X		• Water Quality in State of Ohio
73	Biology Dept. American Univ.		X	X			X					• Put platforms in freshwater and saline wetlands along eastern coastline. Parameters of interest would be: wind direction, humidity, spectral reflectance properties of vegetation
80	Kennecott Copper (Exploration)								X		X	• Ocean Mining: Weater forecasting, communications, oceanographic data
84	Corp. of Engrs. U.S. Army			X			X	X				• Operation and Management of Corps Reservoir System in New England

TABLE 3.4

USER APPLICATION DATA

ID	Organization	Agriculture	Ecology	Environmental Quality	Forestry	Geology	Hydrology	Meteorology	Oceanography	Micrometeorology	Permafrost Studies	Cartography	Specific Experiments/Applications
91	Governor's State University, Illinois		X	X		X	X		X				
94	USDA Soil Conserv. Service	X	X	X	X	X	X	X					• Snow Survey, Prepare and Develop Water Supply Forecasting
95	Terrain Analysis Br. USAE Waterways Exp. Station		X	X	X	X	X			X			• Temperature Isolation, Wind Velocity, Rainfall, Atmospheric Pressure, Water Quality; Dissolved 0_2, Conductivity, pH, Temperature, Depth
97	Dept. of Geog. Southern Oregon College	X	X				X	X					
101	U.S. Cold Regions Research and Eng. Lab.		X	X	X		X				X		• Studies in remote areas of the arctic and subarctic. Measure various environmental parameters over time periods from a single season to several years.
104	New York Ocean Science Lab								X				• Buoys and Towers in northeast coastal area; principally the New York Bight
105	Dept. of Geography Univ. of Texas	X	X	X								X	• Movement of Nomads in North Africa • Monitor environmental data, e.g., climate, land-use, volume of water flow in the Rio Grande Valley
112	Office of Remote Sensing of Earth Resources Penn State University	X				X	X						
114	Forestry Dept. Michigan State Univ.	X	X	X	X								
116	Univ. of Missouri			X	X	X	X	X					
118	Dept. of Architecture University of Florida		X	X									• Monitor the Growth and patterns of growth of urban systems by remote sensing of the urban energy budget and urban form.

TABLE 3.5

USER APPLICATION DATA

ID	Organization	Agriculture	Ecology	Environmental Quality	Forestry	Geology	Hydrology	Meteorology	Oceanography	Range Management	Wildlife Management	Engineering Data Acquisition	Specific Experiment/Applications
124	U.S. Army Atmospheric Sciences Lab						X	X					• Tactical Meteorological Support to the Army
125	Dept. of Soil Science Univ. of Minnesota	X		X		X							• Monitor water table position, water temperature and soil temperature in large organic soil areas (bogs). - Desires daily, seasonal, and annual fluctuations
132	Natural Resources Management Corp.	X	X	X	X								
133	Agronomy Dept. Univ. of Arkansas	X											• Year round measurement of soil moisture and drought stress in agricultural areas of Arkansas • Measurements would be integrated with agricultural weather forecasts to determine irrigation needs on a near real-time basis.
135	Civil Engineering Dept. Univ. of Tennessee						X						
136	Renewable Resources Center, Univ. of Nevada		X	X	X					X	X		• Telemetry Studies of Big Game • Soil moisture depletion rates in relation to plant vigor
137	Civil Engineering Dept. Univ. of Washington						X		X			X	
140	Geosciences Dept. N.C. State Univ.		X	X		X			X				
145	Atlantic Oceanographic and Meteorology Lab - NOAA							X	X				• Position location for free drifting oceanographic buoys
146	NCAR		X	X				X	X				• Ocean Surface data; wind velocities, air temperature, pressure, water temperature • Dynamics of the ocean and the atmosphere • Reversals of wind field in stratosphere • Dispersion and diffusion of the atmosphere • GARP global to synoptic models for GATE and oceanographic experiments

TABLE 3.6
USER APPLICATION DATA

ID	Organization	Agriculture	Ecology	Environmental Quality	Forestry	Geology	Hydrology	Meteorology	Oceanography	Fisheries	Zoology	Planetary Exploration	Wildlife Management	Specific Experiment/Applications
153	NMFS								X	X				• Video and infrared photos for use in fisheries
154	Remote Sensing Inst. So. Dakota University	X	X	X		X	X							
156	Fishery Research Institute, Univ. of Washington								X	X				• High seas fishery studies • Near real-time population enumeration of sockeye Salmon • Remote acoustic sensors placed in Bristol Bay to acquire population data
160	NMFS								X					• Tracking drifting buoys for periods of several months or longer in Central Pacific. Major parameter of interest is position as a function of time • Ocean current studies
170	Dept. of Vertebrate Zoology National Museum of Natural History		X								X			• Tracking individual birds at sea to determine favored feeding grounds during breeding and pre-post-breeding dispersal
193	Marine Science Inst. Univ. of Texas		X	X		X			X					
235	SOUMI			X				X				X		• Refine designs of data collection platforms and study the feasibility of random deployed data gathering system
236	Institute of Agricultural Sciences, Univ. of Alaska	X	X	X										• Gather data on sal temperature at two depths, horizontal wind travel, temperature and humidity of the air, rainfall and global hemispherical radiation from a number of isolated locations within Alaska
242	School of Forest Resources Univ. of Georgia		X										X	• Censusing large game using infrared line-scanning • Telemetry data from deer and bobcats

TABLE 3.7

USER APPLICATION DATA

ID	ORGANIZATION	Agriculture	Ecology	Environmental Quality	Forestry	Geology	Hydrology	Meteorology	Oceanography	Photogrammetric Mapping	Specific Experiment/Applications
243	Univ. of Alabama	X	X	X	X	X	X	X	X		• Applicability of data from terrestrial sensor platforms and data from orbital platforms for inventory and management of the natural resources and improvement of environmental quality in Alabama and the surrounding region.
246	Panel on Hydrology Univ. of Illinois			X			X	X	X		• Develop Global Hydrological System Model
248	College of Forestry S.U.N.Y.			X	X					X	
250	Joint Tsunami Research Effort - Hawaii Inst. of Geophysics								X		• Tsunami— want to produce a real-time mid-ocean tsunami data reporting system
251	Arctic Inst. of North America										
252	Office of Remote Sensing of Earth Resources Penn State Univ.										
256	National Data Buoy Program			X				X	X		• FNWS NODC weather forecasting documentation for research • Wind velocity, air temperature moisture content, rainfall, radiation, barometric pressure, surface roughness, current velocity, sea temperature, sea pressure
261	Coastal Mapping Division National Ocean Survey NOAA										• Transmitting data (digital) from buoys and fixed sites, and imagery in digital form from aircraft
262	Marine Geophysics Group National Ocean Survey										• Magnetic field control for marine geophysical survey data • Tide Correction for Bathymetric Surveys - Magnetometer, Tide Gage, Current Meter

TABLE 3.8

AGRICULTURE EXPERIMENTS/APPLICATION

User ID Number	Description
33	Real time decision making for cloud seeding project
50	—
71	Water quality in the state of Ohio
94	Water supply forecasting
97	—
105	Monitor environmental data, e.g., climate, land-use volume of water flow in the Rio Grande Valley
112	—
114	—
125	Monitor water table position, water temperature and soil temperature in large organic soil areas (bogs)
132	—
133	Year round measurement of soil moisture and drought stress in Arkansas. Integrate with agriculture weather forecasts to determine irrigation needs in near real time
154	—
236	Gather data on soil temperature at two depths
243	Applicability of data from terrestrial sensor platforms and data from orbital platforms for inventory and management of the natural resources and improvement of environmental quality in Alabama and the surrounding region

TABLE 3.9

FORESTRY EXPERIMENTS/APPLICATIONS

User ID Number	Description
31	Fire weather warning
32	Program management and research
50	—
55	Monitoring forest stress to identify earliest possible time for airborne (space borne) detection of stress by remote sensing
55	Monitoring target(s) irradiance as an aid to identifying vegetation snd land use types and change on remote sensing imagery
71	Water quality in state of Ohio
94	Snow survey, prepare and develop water supply forecasting
95	Water quality
101	Studies in remote areas of the arctic and subarctic
114	—
116	—
132	—
136	Soil moisture depletion rates in relation to plant vigor
243	Applicability of data from terrestrial sensor platforms and data from orbital platforms for inventory and management of the natural resources and improvement of environmental quality in Alabama and the surrounding region
248	—

TABLE 3.10

GEOLOGY EXPERIMENTS/APPLICATIONS

User ID Number	Description
17	All short lived, natural, and unpredictable phenomena that occur anywhere on earth, e.g., volcanoes, earthquakes, landslides
30	—
32	Program management and research
33	Avalanche prediction and historical data for system evaluation
71	Water quality in state of Ohio
91	—
94	Snow survey, prepare and develop water supply forecasting
112	—
116	—
125	Monitor water table position, water temperature and soil temperature in large organic soil areas (bogs)
140	—
154	—
193	—
243	Applicability of data from terrestrial sensor platforms and data from orbital platforms for inventory and management of the natural resources and improvement of environmental quality in Alabama and the surrounding region.

TABLE 3.11

HYDROLOGY EXPERIMENTS/APPLICATIONS

User ID Number	Description
17	All short lived natural, and predictable phenomena that occur anywhere on earth
30	—
31	Water supply prediction, snow melt forecasts, flood forecasts
32	River level data, program management and research
33	Real time decision making for cloud seeding project
34	Use of satellite to transmit data for operation of an integrated hydroelectric/thermal-electric power station
50	—
57	—
71	Water quality in state of Ohio
73	Study of fresh water and saline wetlands along eastern coastline
84	Operation and management of corps reservoir system in New England
91	—
94	Prepare and develop water supply forecasting
95	Water quality
97	—
101	Studies in remote areas of the arctic and subarctic. Measure various environmental parameters over time periods from a single season to several years
112	—
116	—
124	Tactical meteorological support to the Army

TABLE 3.11 (Cont)

User ID Number	Description
135	—
137	—
154	—
243	Applicability of data from terrestrial sensor platforms and data from orbital platforms for inventory and management of the natural resources and improvement of environmental quality in Alabama and the surrounding region
246	Develop global hydrological system model

TABLE 3.12

METEOROLOGICAL EXPERIMENTS/APPLICATIONS

User ID Number	Description
4	Air temperature, wind velocity to support fishery studies
17	All short lived, natural, and unpredictable phenomena that occur anywhere on earth
24	Long range O/A climate prediction
30	—
31	Fire weather warning, water supply prediction , flood forecast
33	Real time decision making for cloud seeding project, Historical data
34	Use of satellite to transmit data for operation of an integrated hydroelectric/thermal-electric power station
64	Weather and ice prediction service
66	Arctic research - prediction of natural processes such as weather and ice condition(?)
71	Water quality in state of Ohio
84	Operation and management of Corps Resevoir System in New England
94	Snow survey, prepare and develop water supply forecasting
97	—
116	—
124	Tactical meteorological support to the Army
145	Position location for free drifting oceanographic buoys
146	Ocean surface data, dynamics of the atmosphere, reversals of wind field in stratosphere, dispersion and diffusion of the atmosphere, GARP/GATE (?)
235	Refine designs of data collection platforms and study the feasibility of random deployed data gathering system

TABLE 3.12 (Cont)

User ID Number	Description
243	Applicability of data from terrestrial sensor platforms and data from orbital platforms for inventory and management of the natural resources and improvement of environmental quality in Alabama and the surrounding region
246	Water supply predictions via weather forecasts
256	FNWS NODC weather forecasting documentation for research

TABLE 3.13

OCEANOGRAPHIC EXPERIMENTS/APPLICATION

User ID Number	Description
4	Temperature, salinity, O_2 concentration in Gulf of Mexico, loop current study in Gulf of Mexico., both in support of fishery studies
17	All short lived, natural and unpredictable phenomena that occur anywhere on earth; oilspills, tsunami
19	Oceanographic studies in support behavorial studies of marine animals, migration routes, etc.
21	Presumably tracking icebergs and sea ice studies
23	Great lakes survey
24	Long range O/A climate prediction
30	—
32	Program management and research; river level data, temperature humidity, wind speed, and precipitation
57	—
64	Ice prediction service
66	Feasibility, calculation of geostrophic wind. Geostrophic wind vs ice drift forecasting
80	Oceanographic data in support of ocean mining
91	—
104	Buoys and towers in northeast coastal area; principally in the New York Bight
137	—
140	—
145	Position location for free drifting oceanographic buoys
146	Ocean surface data, dynamics of the ocean
153	Video and infrared photos for use in fisheries

TABLE 3.13 (Cont)

User ID Number	Description
156	Oceanographic studies in support of fisheries studies
160	Ocean current studies
193	—
243	Applicability of data from terrestrial sensor platforms and data from orbital platforms for inventory and management of the natural resources and improvement of environmental quality in Alabama and the surrounding region
246	Develop global hydrological system model
250	Tsunami - want to produce a real-time mid-ocean tsunami data reporting system
256	FNWS NODC weather forecasting, documentation for research

TABLE 3.14

ECOLOGY EXPERIMENTS/APPLICATIONS

User ID Number	Description
4	Temperature salinity, O_2 concentration in Gulf of Mexico, loop current study, Gulf of Mexico
17	All short lived, natural, and unpredictable phenomena that occur anywhere on earth, such as: volcanoes, earthquakes, landslides, oilspills, fish and bird kills, animal and insect colonization and migration, bright fire balls, meteorite falls, and urgent archaelogical and anthrological events
19	Behavioral opological studies of marine animals; migration routes, etc.
30	—
31	Fire weather warning, avalanche warning, water supply prediction, snow melt forecasts, flood forecasts
32	Program management and research
33	Historical data for system evaluation
38	Development of winter severity levels for deer wintering areas. Effects of environmental influence part-climate on deer productivities. Movement patterns between summer and winter ranges for deer
57	—
63	MOSES: Ground truth station for spaceborne sensors, also use satellite to transmit MOSES data to an EDP center for near real time processing and feedback and assistance in precise location and tracking of MOSES when it is free drifting
71	Water quality in state of Ohio
73	Put platforms in fresh water and saline wetlands along eastern coastline. Parameters of interest would be wind direction, humidity, spectral reflectance, properties of vegetation

TABLE 3.14 (Cont)

User ID Number	Description
91	—
94	Snow survey, prepare and develop water supply forecasting
95	Water quality
97	—
101	Studies in remote areas of the arctic and subarctic, measure various environmental parameters over time periods from a single season to several years
105	Movement of Nomads in North Africa
114	—
118	Monitor growth and patterns of growth of urban systems by remote
132	—
136	Telemetry studies of big game. Soil moisture depletion rates in relation to plant vigor
140	—
146	Ocean surface data, dynamics of the ocean and the atmosphere, reversals of wind field in the stratosphere, dispersion and diffusion at the atmosphere, GARP global to synoptic models for GATE and oceanographic experiments
154	—
170	Tracking individual birds at sea to determine favored feeding grounds during breeding andpre/post-breeding dispersal
193	—
236	Gather data on soil temperature at two depths, horizontal wind travel, temperature and humidity of the air, rainfall and global hemispherical radiation from a number of isolated locations within Alaska
242	Consusing large game using infrared line-scanning telemetry data from deer and bobcats

TABLE 3.14 (Cont)

User ID Number	Description
243	Applicability of data from terrestrial sensor platforms and data from orbital platforms for inventory and management of the natural resources and improvement of environmental quality in Alabama and the surrounding region

TABLE 3.15

ENVIRONMENTAL QUALITY EXPERIMENTS/APPLICATION

User ID Number	Description
4	Temperature salinity, O_2 concentration in Gulf of Mexico Loop current study, Gulf of Mexico
17	All short lived, natural, and unpredictable phenomena that occur anywhere on earth
19	Behavioral studies
30	—
31	Fire weather warning, avalanche warning, water supply prediction, snow melt forecasts, flood forecasts
32	Program management and research
33	Real time decision making for cloud seeding project and avalanche prediction and historical data for system evaluation
57	—
71	Water quality in state of Ohio
73	Put platforms in fresh water and saline wetlands along eastern coastline. Parameters of interest would be wind direction, humidity, spectral reflection properties of vegetation
84	Operation and management of Corps Reservoir System in New England
91	—
94	Prepare and develop water supply forecasting
95	Water Quality
101	Studies in remote areas of the arctic and subarctic. Measure various environmental parameters over time periods from a single season to several years
114	—
116	—
118	Monitor the growth and patterns of growth of urban systems by remote sensing of the urban energy budget and urban form

TABLE 3.15 (Cont)

User ID Number	Description
125	Monitor water table position, water temperature and soil temperature in large organic soil areas (bogs)
132	—
136	Telemetry studies of big game. Soil moisture depletion rates in relation to plant vigor
140	—
146	Ocean surface data, dynamics of the ocean and the atmosphere, reversals of wind field in stratosphere, dispersion and diffusion of the atmosphere, GARP global to synoptic models for GATE and oceanographic experiments
154	—
193	—
235	Refine designs of data collection platforms and study the feasibility of random deployed data gathering system
236	Gathering data on soil temperature at two depths, horizontal wind travel, temperature and humidity of the air, rainfall and global hemispherical radiation from a number of isolated locations within Alaska
243	Applicability of data from terrestrial sensor platforms and data from orbital platforms for inventory and management of the natural resources and improvement of environmental quality in Alabama and the surrounding region
246	Develop global hydrological system model
248	—
256	FNWS NODC weather forecasting, documentation for research

TABLE 3.16

OTHER EXPERIMENTS/APPLICATION

User ID Number	Description
	--FISHERIES--
4	Temperature, salinity, O_2 concentration in Gulf of Mexico, air temperature, wind velocity, loop current study - Gulf of Mexico
19	Behavioral studies of marine animals; migration routes, etc.
153	Video and infrared photos for use in fisheries
156	High seas fishery studies, near real-time population enumeration of sockeye salmon - remote acoustic sensors placed in Bristol Bay to acquire population data
	--GEODESY--
23	Great Lakes Survey (NOAA) - Geodesy and Satellite Triangulation
	--ENGINEERING--
9	Correcting errors in spectral signals obtained from satellite due to atmospheric effects
137	—
235	Refine designs of data collection platforms and study the feasibility of random deployed data gathering system
	--PHOTOGRAMMETRY--
23	Great Lakes Survey (NOAA)
248	—

TABLE 3.16 (Cont)

User ID Number	Description
	--WILD LIFE AND RANGE MANAGEMENT--
38	Development of winter severity levels for deer wintering areas. Effects of environmental influence part-climate and deer productivity. Movement patterns between summer and winter ranges for deer
136	Telemetry studies of big game
242	Censusing large game using infrared line-scanning, telemetry data from deer and bobcats
	--INFORMATION/DATA MANAGEMENT--
71	Water quality in state of Ohio
	--OCEAN MINING--
80	Ocean mining, weather forecasting, communications, oceanographic data
	--MICROMETEOROLOGY--
95	Meteorological data for a single locus in great detail
	--PERMAFROST STUDIES--
101	Studies in remote areas of the arctic and subarctic
	--CARTOGRAPHY--
105	Movement of nomads in North Africa. Monitor environmental, e.g., climate, land-use, volume of water flow in the Rio Grande Valley

TABLE 3.16 (Cont)

User ID Number	Description
	--ZOOLOGY--
170	Tracking individual birds at seat to determine favored feeding grounds during brreding and pre/post-breeding dispersal
	--PLANETARY EXPLORATION--
235	Refine designs of data collection platforms and study the feasibility or random deployed data gathering system

TABLE 3.17

AGRICULTURAL PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rate for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Inter-rogateable Platform	Position Location	Platform Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
33	8	3	cts	100 BPS	-10 to +10	10	D	—	NR	1 ft^3	$\pm 30^o$	Unlimited	Rugged	Fixed
50	8	3	24 hr	—	0 to 5	—	—	—	20 Kg NR	W	Fixed	Unlimited	Everyday Abuse	Fixed
71	16	4	cts	—	—	—	D	—	Portable	Trailer Mount	Random	Unlimited	Everyday Abuse	Trailer Mount (Mobile)
94	8	2	1 hr	1,000	0 to 5	16	D	—	20 Kg	W	$\pm 30^o$	Unlimited	Rugged	Fixed
97	4	2	12 hr	100	0 to 5	—	No	—	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
105	16	3	24 hr	—	0 to 5	—	D	D	1 Kg	Gr	Random	Non-existant	Both	Mobile
112	16	3	24 hr	—	-10 to +10	14	No	—	NR	NR	$\pm 15^o$	< 2'	Rugged	Fixed
114	16	4	6 hr	100	-10 to +10	—	D	D	10 Kg	G, O, W, NR	Random	< 6"	Rugged	Animal Fixed
125	8	3	6 hr	100	—	—	No	M	10 Kg	W	Random	Unlimited	Everyday Abuse	Fixed
132	8	3	6 hr	—	0 to 5	8	—	—	1 Kg	O	Random	< 6"	Everyday Abuse	Fixed
133	4	2	24 hr	—	—	—	No	—	10 Kg	Other	Fixed	Unlimited	Everyday Abuse	Fixed
154	16	3	2-3 hr	100	-50 to +50 MV	8	D	—	NR	Other	$\pm 30^o$	Unlimited	Rugged	Fixed
236	8	3	12 hr	—	0 to 5	—	No	—	5 Kg	NR	$\pm 15^o$	< 2'	Everyday Abuse	Fixed
243	16	3	.5 hr	100	0 to 5	—	No	—	50 Kg	W	Fixed and Random	< 2'	Rugged Frangible	Buoys Fixed

TABLE 3.18

AGRICULTURAL PLATFORM DATA

			Environmental Conditions																			
ID	Platform Life	User Cost Estimate	Temperature Range	Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow, Snow Loads	Burial	Vandals, Rodents, etc.	Sustained Low Temperature	Lightning	High Altitude	Dry & Windy	High Seas	Rapid Temperature Change	Rapid Depth Change	Interfacing Currents	Vibration or Impact
33	Indefinite	1K	-50 to +100										X	X	X						
50	5 yrs	500	-50 to +100			X				X											
71	Indefinite	2K	-30 to +100																		
94	Indefinite	2K	-50 to +100		X	X	X						X								
97	1 yr	1K	-50 to +100			X															
105	1 yr	100	+100													X					
112	2 yr	500	-50 to +100			X															
114	Indefinite	500	-50 to +100			X															
125	5 yr	1K	-50 to +100			X	X										X				
132	2 yr	500	-50 to +100			X	X 100 mph					X									
133	2 yr	1K	0 to +100			X															
154	2 yr	—	-50 to +100			X															
236	2 yr	100	-100 to +100			X	X Sustained														
243	Indefinite	1K	-50 to +150	X?	X	X						X Rifle Shot									X

TABLE 3.20

ECOLOGY PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rate for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Interrogateable Platform	Position Location	Platform Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
4	16	2	1 hr	—	U	U	D	—	NR	U	$\pm 30^\circ$	<2'	Rugged	Buoy
17	4	2	24 hr	—	—	—	D	D	—	—	—	—	Everyday Abuse	—
19	8	3	12 hr	—	0 to 5	U	NO	M	10,100 gr 1 kg	G,E,O	$\pm 30^\circ$ Random	Non Ex. 6"	Rugged	Buoy Marine Animal
30	16	3	24 hr	—	-10 to +10	U	D	—	NR	NR	Fixed $\pm 15^\circ$	Unlimited	Everyday Abuse	Oceanographic Vessel
31	8/16	2,3,4	12/24 hr	—	0 to 5 -10 to +10	15/48	D	—	NR	W NR	Random	Unlimited	Rugged	Fixed
32	8	2	.5 hr	—	0 to 5	4	NO	—	10,20, 40 kg	W $1M^3$	$\pm 30^\circ$	Unlimited	Rugged	Buoys Fixed
33	8	3	cts	100	-10 to +10	10	YES	—	NR	1 ft^3	$\pm 30^\circ$	Unlimited	Rugged	Fixed
38	8	2	1 hr	—	-10 to +10	4	—	—	100 gr NR	O	Fixed Random	<6"	Rugged	Animal Fixed
57	8	3	1	—	-10 to +10	11	D	—	NR	W	Fixed	Unlimited	Everyday Abuse	Fixed
63	16	4	6 hr	—	U	U	NO	M	NR	NR	Fixed	Unlimited	Rugged	Manned Spar Buoy
71	16	4	cts	—	—	—	YES	—	Portable	Trailer Mount	Random	Unlimited	Everyday Abuse	Trailer (mobile) Mount
73	8	2	1 wk	100	-10 to +10	—	D	M	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
91	8	4	1 hr	100	0 to 5	<1000	D	M	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
94	8	2	1 hr	1000	0 to 5	16	YES	—	20 kg	W	± 30	Unlimited	Rugged	Fixed
95	>16	2	1 hr	—	Other	5	D	—	10 kg	W	Fixed	<6"	Rugged	Fixed
97	4	2	12 hr	100	0 to 5	—	NO	—	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
101	8	2	2 hr	—	U	U	—	—	20 kg	W	Random	Unlimited	Rugged	Fixed
105	16	3	24 hr	—	0 to 5	—	D	D	1 kg	G	Random	Non-Existent	Both	Mobile (Nomads)
114	16	4	6	100	-10 to +10	—	D	D	10 kg	?	Random		Rugged	Animals Fixed
118	8	2	24 hr	—	—	—	NO	—	NR	W	Random	Unlimited	Everyday Abuse	Buoys, Balloons, Fixed
132	8	3	6 hr	—	0 to 5	8	—	—	1 kg	O	Random	< 6"	Everyday Abuse	Fixed
136	8	3	1 hr	—	-10 to ± 10	—	D	—	10,100 gr 100 kg	E W	$\pm 15^\circ$	Non Ex < 2'	Rugged	Animal Fixed
140	8	3	6 hr	100	-10 to +1-	20	D	—	10 kg	E W	Random	< 2'	Rugged	Buoy Fixed
146	8	3	12 hr	100	0 to 5	8	NO	M	20 kg or NR*	W Tele Pole	$\pm 5^\circ$ $\pm 15^\circ$	< 2'	Rugged	Buoy
154	16	3	2-3 hr	100	-50 to +50 mv	8	D	—	NR	>N	$\pm 30^\circ$	Unlimited	Rugged	Fixed
170	8	2	1 hr	—	—	—	D	M	10,100 gr 1 kg	G,E, O, Gr	$\pm 15^\circ$	< 6"	Rugged	Animal
193	8	3	1 hr	—	0 to 5	—	U	M	NR	NR	$\pm 15^\circ$	Unlimited	Everyday Abuse	Buoy
236	8	3	12 hr	—	0 to 5	—	NO	—	5 kg	NR	$\pm 15^\circ$	< 2'	Everyday Abuse	Fixed
242	4	—	1 hr	—	—	—	NO	M	1 kg	Gr	$\pm 30^\circ$	< 6"	Rugged	Animal
243	16	3	.5 hr	100	0 to 5	—	NO	—	50 kg	W	Fixed & Random	< 2' Unlimited	Rugged Frangible	Buoys Fixed

* Depends on deployment

TABLE 3.21

ECOLOGY PLATFORM DATA

ID	Platform Life	User Cost Estimate	Temperature Range	Environmental Conditions: Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow, Snow Loads	Burial	Vandals, Rodents, etc.	Sustained Low Temperature	Lightning	High Altitude	Dry and Windy	High Seas	Rapid Temperature Change	Rapid Depth Change	Interfacing Currents	Vibration or Impact
4	2 yr	1K	0°F Minimum	X		X	X										X				
17	Indefinite	100/yr	-100° to +100°	X	X	X															
19	1 yr	100 500	0° to +100°	X														X	X		
30	10 yr	—	-50° to +125°	X		X															
31	Indefinite	1K, 5K	-50° to +120°		X	X	X		X	X			X								
32	Indefinite	1K	-100° to +100°			X															
33	Indefinite	1K	-50° to +100°										X	X	X						
38	Indefinite	1K	-50° to +100°		X																
57	5 yr	1K	-50° to +100°			X															
63	5 yr	—	+50° to +100°	X	X	X	X										X large waves				
71	Indefinite	2K	-30° to +100°																		
73	1 yr	5K	0° to +100°		X	X	X														
91	Indefinite	500	-50° to +100°			X	(Corrosion resistant)														
94	Indefinite	2K	-50° to +100°		X	X	X			X			X								
95	Indefinite	500	-50° to +100°	X	X	X	X										X rough water				
97	1 yr	1K	-50° to +100°			X															
101	5 yr	1K	-100° to +100°			X	X	X Rime					X								
105	1 yr	100	+100°F Maximum													X					
114	Indefinite	500	-50° to +100°			X															
118	2 yr	—	0° to +100°			X															
132	2 yr	500	-50° to +100°			X	X 100 mph					X						X 50° Diurnal			
136	5 yr	500	-50° to +100°				X														
140	2 yr	1K	0° to +100°	X	X	X															
146	3 mo Replenish	5K	0° to +50°	X		X															
154	2 yr	—	-50° to +100°			X															
170	2 yr	500	-50° to +100°	X		(Subject to proening)															
193	3 mo	2K	0° to +100°	X		X	X														
236	2 yr	100	-100° to +100°			X	X Sustained														
242	6 mo	100	0° to +100°		X																
243	Indefinite	1K	-50° to +100°	X	X	X	X						X Rifle shot								X

TABLE 3.23

ENVIRONMENTAL QUALITY PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rates for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Interrogateable Platform	Position Location	Platform Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
4	16	2	1 hr	—	U	U	D	—	NR	U	±30°	< 2'	Rugged	Buoy
17	4	2	24 hrs	—	—	—	D	D	—	—	—	—	Everyday Abuse	—
19	8	3	12 hrs	—	0 to 5	U	No	M	10, 100 Gr 1 Kg	G, E, O	±30° Random	Non-existant < 6"	Rugged	Buoy Marine Animal
23	16	3	.5 hr	1,000	-10 to +10	—	D	—	NR	NR	Fixed ±15°	Unlimited	Rugged	Buoy Fixed
30	16	3	24 hrs	—	-10 to +10	U	D	—	NR	NR	Fixed ±15°	Unlimited	Everyday Abuse	Oceanogr. Vessel
31	8/16	2, 3, 4	12/24 hrs	—	0 to 5 -10 to +10	15/48	D	—	NR	W, NR	Random	Unlimited.	Rugged	Fixed
32	8	2	.5 hr	—	0 to 5	4	No	—	10, 20, 40 Kg	W, 1M³	±30°	Unlimited	Rugged	Buoys Fixed
33	8	3	cts	100	-10 to +10	10	Yes	—	NR	1 ft³	±30°	Unlimited	Rugged	Fixed
57	8	3	1 hr	—	-10 to +10	11	D	—	NR	W	Fixed	Unlimited	Everyday Abuse	Fixed
71	16	4	cts	—	—	—	Yes	—	Portable	Trailer Mount	Random	Unlimited	Everyday Abuse	Mobile Trailer Mount
73	8	2	1 wk	100	-10 to +10	—	D	M	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
84	4	2	1, 2, 6 hrs*	100	0 to 5	16	D	—	20 Kg	W	Random	< 2'	Rugged	Fixed
91	8	4	1 hr	100	0 to 5	<1,000	D	M	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
94	8	2	1 hr	1,000	0 to 5	16	Yes	—	20 Kg	W	±30°	Unlimited	Rugged	Fixed
95	>16	2	1 hr	—	Other	5	D	—	10 Kg	W	Fixed	< 6"	Rugged	Fixed
101	8	2	2 hr	—	U	U	—	—	20 Kg	W	Random	Unlimited	Rugged	Fixed
105	16	3	24 hrs	—	0 to 5	—	D	D	1 Kg	G	Random	Non-existant	Both	Mobile
114	16	4	6 hrs	100	-10 to +10	—	D	D	10 Kg	—	Random	< 6"	Rugged	Animals Fixed
116	8	4	2 hrs	1,000	-10 to +10	7	No	No	NR	NR	Fixed	< 2'	Everyday Abuse	Fixed
118	8	2	24 hrs	—	—	—	No	—	NR	W	Random	Unlimited	Everyday Abuse	Buoys, Fixed Balloons
125	8	3	6 hrs	100	—	—	No	M	10 Kg	W	Random	Unlimited	Everyday Abuse	Fixed
132	8	3	6 hrs	—	0 to 5	8	—	—	1 Kg	O	Random	< 6"	Everyday Abuse	Fixed
136	8	3	1 hr	—	-10 to +10	—	D	—	10; 100 Gr 1 Kg	E, W	±15°	Non-existant < 2'	Rugged	Animals Fixed
140	8	3	6 hrs	100	-10 to +10	20	D	—	10 Kg	E, W	Random	< 2'	Rugged	Buoys Fixed
146	8	3	12 hrs	100	0 to 5	8	U	M	20 Kg or NR**	W, Telep. Pole	± 5° ±15°	< 2'	Rugged	Buoys
154	16	3	2-3 hrs	100	-50 to +50 MV	8	D	—	NR	> W	±30°	Unlimited	Rugged	Fixed
193	8	3	1 hr	—	0 to 5	—	U	M	NR	NR	±15°	Unlimited	Everyday Abuse	Buoys
235	8	4	2 hrs	100	±12 Vdc	10	No	M	1 Kg	GR, W	±5°	< 2'	Frangible	Balloons
236	8	3	12 hrs	—	0 to 5	—	No	—	5 Kg	NR	±15°	< 2'	Everyday Abuse	Fixed
243	16	3	.5 hr	100	0 to 5	—	No	—	50 Kg	W	Fixed and Random	< 2' Unlimited	Rugged Frangible	Buoys Fixed
246	16	3	cts	1,000	0 to 5	—	D	D	NR	W	Fixed	Unlimited	Rugged	Fixed
248	8	4	1 hr	100	-10 to +10	32	No	M	100 Gr 100 Kg	2 ft³, E	±15° Random	Non-existant Unlimited	Everyday Abuse	Animals Fixed
256	16, 100	4	3/6 hr	300	NA	16	M	M	20 Kg, NR	W, NR	±30°	Unlimited	Rugged	Buoy

* depends on conditions.
** depends on deployment.

TABLE 3.24

ENVIRONMENTAL QUALITY PLATFORM DATA

ID	Platform Life	User Cost Estimate	Environmental Conditions: Temperature Range	Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow, Snow Loads	Burial	Vandals, Rodents, etc	Sustained Low Temperature	Lightning	High Altitude	Dry and Windy	High Seas	Rapid Temperature Change	Rapid Depth Change	Interfacing Currents
4	2 yr	1 K	0° F Minimum	X		X	X									X	Variable Sea State			
17	Indefinite	100 per year	-100° to $+100^{\circ}$	X	X	X														
19	1 yr	100,500	0° to 100°	X														X	X	
23	Indefinite	—	-50° to $+50^{\circ}$			X														
30	10 yr	—	-50° to $+125^{\circ}$	X		X														
31	Indefinite	1K,5K	-50° to $+120^{\circ}$		X	X	X		X	X			X							
32	Indefinite	1K	-100° to $+100^{\circ}$			X														
33	Indefinite	1K	-50° to $+100^{\circ}$										X	X	X					
57	5 yr	1K	-50° to $+100^{\circ}$			X														
71	Indefinite	2K	-30° to $+100^{\circ}$																	
73	1 yr	5K	0° to $+100^{\circ}$		X	X	X													
84	Indefinite	1K	-50° to $+100^{\circ}$			X	X 125 mph													
91	Indefinite	500	-50° to $+100^{\circ}$			X	(Corrosion resistant X)													
94	Indefinite	2K	-50° to $+100^{\circ}$		X	X	X			X			X							
95	Indefinite	500	-50° to $+100^{\circ}$	X	X	X	X										X Rough Water			
101	5 yr	1K	-100° to $+100^{\circ}$			X	X	X Rime Ice					X							
105	1 yr	100	+100 max													X				
114	Indefinite	500	-50° to $+100^{\circ}$			X														
116	2 yr	2K	-50° to $+100^{\circ}$			X														
118	2 yr	—	0° to $+100^{\circ}$			X														
125	5 yr	1K	-50° to $+100^{\circ}$			X	X													
132	2 yrs	500	-50° to $+100^{\circ}$			X	X 100 mph					X								
136	5 yrs	500	-50° to $+100^{\circ}$				X											X Diurnal 50°		
140	2 yrs	1,000	0° to $+100^{\circ}$	X	X	X														
146	3 mo (Replenish)	5K	0° to $+100^{\circ}$	X		X														
154	2 yrs	—	-50° to $+100^{\circ}$			X														
193	3 mo	2K	0° to +100	X		X	X													
235	1 yr	2K	-100° to $+100^{\circ}$			X	X 50-70 mph	(Operate at 0°C after coming out of -50°C storage for 11 hours)												
236	2 yr	100	-100° to $+100^{\circ}$			X	X Sustained													
243	Indefinite	1K	-50° to $+150^{\circ}$	X	X	X	X					X Rifle Shot	(Vibration) (Impact)							
246	Indefinite	5K	-50° to $+50^{\circ}$			X	X													
248	5 yr	—	-100° to $+100^{\circ}$			X	X			X Deep snow			X							
256	1yr Indefinite	5K	0° to $+100^{\circ}$	X			X					(Surface currents > 5 kts.)					X (Large acceleration > 1 g)			

TABLE 3.26

FORESTRY PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rate for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Interrogateable Platform	Position Location	Platform Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
31	8/16	2,3,4	12/24	—	0 to 5	15/48'	D	—	NR	W, NR	Random	Unlimited	Rugged	Fixed
32	8	2	.5	—	-10 to +10	4	No	—	10,20, 40 Kg	W $1M^3$	$\pm 30^{\circ}$	Unlimited	Rugged	Buoys Fixed
50	8	3	24	—	0 to 5	—	—	—	20 Kg NR	W	Fixed	Unlimited	Everyday Abuse	Fixed
55	16	2	12	—	0 to 5	5	No	—	20 Kg 1 Kg	NR, W	$\pm 5^{\circ}$	< 2'	Rugged	Fixed
71	16	4	cts	—	—	—	Yes	—	Portable	Trailer Mount	Random	Unlimited	Everyday Abuse	Mobile Trailer Mount
94	8	2	1	1,000	0 to 5	16	Yes	—	20 Kg	W	$\pm 30^{\circ}$	Unlimited	Rugged	Fixed
95	>16	2	1	—	Other	5	D	—	10 Kg	W	Fixed	< 6"	Rugged	Fixed
101	8	2	2	—	U	U	—	—	20 Kg	W	Random	Unlimited	Rugged	Fixed
114	16	4	6	100	-10 to +10	—	D	D	10 Kg	—	Random	< 6"	Rugged	Animals Fixed
116	8	4	2	1,000	-10 to +10	7	No	No	NR	NR	Fixed	< 2'	Everyday Abuse	Fixed
118	8	2	24	—	—	—	No	—	NR	W	Random	Unlimited	Everyday Abuse	Buoys, Fixed Balloons
132	8	3	6	—	0 to 5	8	—	—	1 Kg	O	Random	< 6"	Everyday Abuse	Fixed
136	8	3	1	—	-10 to +10	—	D	—	10, 100 gr 1 Kg	E, W	$\pm 15^{\circ}$	Non- existant, < 2'	Rugged	Animals, Fixed
243	16	3	.5	100	0 to 5	—	No	—	50 Kg	W	Fixed and Random	< 2' Unlimited	Rugged Frangible	Buoys Fixed
248	8	4	1	100	-10 to +10	32	No	M	100 gr. 100 Kg	E $2 ft^3$	$\pm 15^{\circ}$ Random	Non- existant Unlimited	Everyday Abuse	Animals Fixed

TABLE 3.27

FORESTRY PLATFORM DATA

ID	Program Life	User Cost Estimate	Environmental Conditions: Temperature Range	Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow, Snow Loads	Burial	Vandals, Rodent, etc.	Sustained Low Temperature	Lightning	High Altitude	Dry and Windy	High Seas	Rapid Temperature Change	Rapid Depth Change	Interfacing Currents
31	Indefinite	1K, 5K	-50° to $+100^{\circ}$		X	X	X		X	X			X							
32	Indefinite	1K	-100° to $+100^{\circ}$			X														
50	5 yrs	500	-50° to $+100^{\circ}$			X														
55	2 yrs	2K	-50° to $+100^{\circ}$			X							X							
71	Indefinite	2K	-30° to $+100^{\circ}$																	
94	Indefinite	2K	-50° to $+100^{\circ}$		X	X	X			X			X							
95	Indefinite	500	-50° to $+100^{\circ}$	X	X	X	X										X Rough water			
101	5 yrs	1K	-100° to $+100^{\circ}$			X	X	X Rime ice					X							
114	Indefinite	500	-50° to $+100^{\circ}$			X														
116	2 yrs	2K	-50° to $+100^{\circ}$			X														
118	2 yrs	—	0° to $+100^{\circ}$			X														
132	2 yrs	500	-50° to $+100^{\circ}$			X	X 100 mph					X								
136	5 yrs	500	-50° to $+100^{\circ}$				X											X Diurnal 50°		
243	Indefinite	1K	-50° to $+100^{\circ}$	X	X	X	X					X Rifle shot	(Vibration X) (Impact X)							
248	5 yrs	—	-100° to $+100^{\circ}$			X	X			X Deep snow										

TABLE 3.29

GEOLOGY PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rate for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Interrogateable Platform	Position Location	Platform Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
17	4	2	24	—	—	—	D	D	—	—	—	—	Everyday Abuse	—
30	16	3	24	—	-10 to +10	U	D	—	NR	NR	Fixed $\pm 15^{o}$	Unlimited	Everyday Abuse	Oceanogr. Vessel
32	8	2	.5	—	0 to 5	4	No	—	10, 20, 40 Kg	W, $1M^3$	$\pm 30^{o}$	Unlimited	Rugged	Buoys Fixed
33	8	3	cts	100	-10 to +10	10	Yes	—	NR	1 ft^3	$\pm 30^{o}$	Unlimited	Rugged	Fixed
71	16	4	cts	—	—	—	Yes	—	Portable	Trailer, Mount	Random	Unlimited	Everyday Abuse	Mobile Trailer Mount
91	8	4	1	100	0 to 5	<1,000	D	M	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
94	8	2	1	1,000	0 to 5	16	Yes	—	20 Kg	W	$\pm 30^{o}$	Unlimited	Rugged	Fixed
95	>16	2	1	—	Other	5	D	—	10 Kg	W	Fixed	< 6"	Rugged	Fixed
112	16	3	24	—	-10 to +10	14	No	—	NR	NR	$\pm 15^{o}$	< 2'	Rugged	Fixed
116	8	4	2	1,000	-10 to +10	7	No	No	NR	NR	Fixed	< 2'	Everyday Abuse	Fixed
125	8	3	6	100	—	—	No	M	10 Kg	W	Random	Unlimited	Everyday Abuse	Fixed
140	8	3	6	100	-10 to +10	20	D	—	10 Kg	E, W	Random	< 2'	Rugged	Buoys Fixed
154	16	3	2-3	100	-50 to +50 MV	8	D	—	NR	> W	$\pm 30^{o}$	Unlimited	Rugged	Fixed
193	8	3	1	—	0 to 5	—	U	M	NR	NR	$\pm 15^{o}$	Unlimited	Everyday Abuse	Buoys
243	16	3	.5	100	0 to 5	—	No	—	50 Kg	W	Fixed Random	< 2' Unlimited	Rugged Frangible	Buoys Fixed

TABLE 3.30

GEOLOGY PLATFORM DATA

ID	Program Life	User Cost Estimate	Environmental Conditions																		
			Temperature Range	Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow, Snow Loads	Burial	Vandals, Rodent, etc.	Sustained Low Temperature	Lightning	High Altitude	Dry and Windy	High Seas	Rapid Temperature Change	Rapid Depth Change	Interfacing Current	Vibration or Impact
17	Indefinite	100 per year	-100° to $+100^{\circ}$	X	X	X															
30	10 yrs	—	-50° to $+125^{\circ}$	X		X															
32	Indefinite	1K	-100° to $+100^{\circ}$			X															
33	Indefinite	1K	-50° to $+100^{\circ}$										X	X	X						
71	Indefinite	2K	-30° to $+100^{\circ}$																		
91	Indefinite	500	-50° to $+100^{\circ}$			X	(Corrosion resistant X)														
94	Indefinite	2K	-50° to $+100^{\circ}$		X	X	X			X			X								
95	Indefinite	500	-50° to $+100^{\circ}$	X	X	X	X										X Rough water				
112	2 yrs	500	-50° to $+100^{\circ}$			X															
116	2 yrs	2K	-50° to $+100^{\circ}$			X															
125	5 yrs	1K	-50° to $+100^{\circ}$			X	X														
140	2 yrs	1,000	0° to $+100^{\circ}$	X	X	X															
154	2 yrs	—	-50° to $+100^{\circ}$			X															
193	3 mo	2K	0° to $+100^{\circ}$	X		X	X														
243	Indefinite	1K	-50° to $+150^{\circ}$	X	X	X	X					X Rifle shot	(Vibration X) (Impact X)								

TABLE 3.32

HYDROLOGY PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rates for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Interrogateable Platform	Position Location	Position Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
17	4	2	·24 hrs	—	—	—	D	D	—	—	—	—	Everyday Abuse	—
30	16	3	24 hrs	—	-10 to +10	U	D	—	NR	NR	Fixed $\pm 15^{\circ}$	Unlimited	Everyday Abuse	Oceanogr. Vessel
31	8/16	2,3,4	12/24	—	0 to 5 -10 to +10	15/48	D	—	NR	W, NR	Random	Unlimited	Rugged	Fixed
32	8	2	.5	—	0 to 5	4	No	—	10, 20 40 Kg	W, IM^3	$\pm 30^{\circ}$	Unlimited	Rugged	Buoys Fixed
33	8	3	cts	100	-10 to +10	10	Yes	—	NR	1 ft^3	$\pm 30^{\circ}$	Unlimited	Rugged	Fixed
34	4	4	24 hrs	—	0 to 5	—	—	—	NR	NR	Fixed	Unlimited	Rugged	Fixed
50	8	3	24 hrs	—	0 to 5	—	—	—	30 Kg NR	W	Fixed	Unlimited	Everyday Abuse	Fixed
57	8	3	1 hr	—	-10 to +10	11	D	—	NR	W	Fixed	Unlimited	Everyday Abuse	Fixed
71	16	4	cts	—	—	—	Yes	—	Portable	Trailer Mount	Random	Unlimited	Everyday Abuse	Mobile Trailer Mount
73	8	2	1 wk	100	-10 to +10	—	D	M	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
84	4	2	1, 2, 6 hrs*	100	0 to 5	16	D	—	20 Kg	W	Random	<2'	Rugged	Fixed
91	8	4	1 hr	100	0 to 5	<1,000	D	M	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
94	8	2	1 hr	1,000	0 to 5	16	Yes	—	20 Kg	W	$\pm 30^{\circ}$	Unlimited	Rugged	Fixed
95	>16	2	1 hr	—	Other	5	D	—	10 Kg	W	Fixed	< 6"	Rugged	Fixed
97	4	2	12 hrs	100	0 to 5	—	No	—	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
101	8	2	2 hrs	—	U	U	—	—	20 Kg	W	Random	Unlimited	Rugged	Fixed
112	16	3	12 hrs	—	-10 to +10	14	No	—	NR	NR	$\pm 15^{\circ}$	< 2'	Rugged	Fixed
116	8	4	2 hrs	1,000	-10 to +10	7	No	No	NR	NR	Fixed	< 2'	Everyday Abuse	Fixed
124	8	2	.5 hrs	—	110 to +10	4	No	M	NR	NR	Fixed	Unlimited	Rugged	Fixed
135	8	3	2 hrs	—	0 to 5	4	D	—	NR	Not Important	Fixed	Unlimited	Rugged	Fixed
137	8	4	24 hrs	—	—	—	D	M	NR	NR	Random	Unlimited	Rugged	Fixed
154	16	3	2-3 hrs	100	-50 to +50 MV	8	D	—	NR	> W	$\pm 30^{\circ}$	Unlimited	Rugged	Fixed
243	16	3	.5 hrs	100	0 to 5	—	No	—	50 Kg	W	Fixed Random	< 2' Unlimited	Rugged Frangible	Buoys Fixed
246	16	3	cts	1,000	0 to 5	—	D	D	NR	W	Fixed	Unlimited	Rugged	Fixed

* Depending on Conditions.

TABLE 3.33

HYDROLOGY PLATFORM DATA

ID	Platform Life	User Cost Estimate	Temperature Range	Environmental Conditions: Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow, Snow Loads	Burial	Vandals, Rodents, etc.	Sustained Low Temperature	Lightning	High Altitude	Dry & Windy	High Seas	Rapid Temperature Change	Rapid Depth Change	Interfacing Currents	Vibration or Impact
17	Indefinite	100/yr	-100 to +100	X	X	X			X	X											
30	10 yrs	—	-50 to +125	X		X															
31	Indefinite	1K,5K	-50 to +120		X	X	X						X	X	X						
32	Indefinite	1K	-100 to +100			X															
33	Indefinite	1K	-50 to +100										X								
34	2 yrs	2K	-50 to +100		X	X															
50	5 yrs	500	-50 to +100			X															
57	5 yrs	1K	-50 to +100			X															
71	Indefinite	2K	-30 to +100																		
73	1 yr	5K	0 to +100		X	X	X														
84	Indefinite	1K	-50 to +100			X	X 125 mph														
91	Indefinite	500	-50 to +100			X (Corrosion Resistant X)															
94	Indefinite	2K	-50 to +100		X	X	X			X			X								
95	Indefinite	500	-50 to +100	X	X	X	X										X				
97	1 yr	1K	-50 to +100			X															
101	5 yr	1K	-100 to +100			X	X	X Rime					X								
112	2 yr	500	-50 to +100			X															
116	2 yr	2K	-50 to +100			X															
124	1 yr	500	-50 to +100			X															
135	Indefinite	—	0 to +100			X						X									
137	2 yrs	2K	-50 to +100	X																	
154	2 yrs	—	-50 to +100			X															
243	Indefinite	1K	-50 to +150	X	X	X	X					X Rifle Shot									X
246	Indefinite	5K	-50 to +50			X	X														

TABLE 3.35

METEOROLOGY PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rates for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Interrogateable Platform	Position Location	Platform Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
4	16	2 digits	1 hr	—	U	U	D	—	NR	U	$\pm30^{\circ}$	< 2'	Rugged	Buoy
17	4	2	24 hrs	—	—	—	D	D	—	—	—	—	Everyday Abuse	—
24	16	2	1 hr	—	-10 to +10	12	D	M	NR	NR	$\pm30^{\circ}$	Unlimited	Rugged	Buoy Fixed
30	16	3	24 hr	—	-10 to +10	U	D	—	NR	NR	Fixed $\pm15^{\circ}$	Unlimited	Everyday Abuse	Oceanogr. Vessel
31	8/16	2,3,4	12/24	—	0 to 5 -10 to +10	15/48	D	—	NR	W, NR	Random	Unlimited	Rugged	Fixed
33	8	3	cts	100	-10 to +10	10	Yes	—	NR	1 ft^3	$\pm30^{\circ}$	Unlimited	Rugged	Fixed
34	4	4	24 hrs	—	0 to 5	—	—	—	NR	NR	Fixed	Unlimited	Rugged	Fixed
64	8	3	1 hr	—	U	10	D	M	100 Kg	W	$\pm15^{\circ}$	< 2'	Rugged	Buoys
66	4	4	1 hr	—	0 to 5	10	D	M	10 Kg	W Fit in 8" Pipe	Fixed	Unlimited	Rugged	Buoys
71	16	4	cts	—	—	—	Yes	—	Portable	Trailer Mount	Random	Unlimited	Everyday Abuse	Mobile Trailer Mount
84	4	2	1,2,6 hr*	100	0 to 5	16	D	—	20 Kg	W	Random	< 2'	Rugged	Fixed
94	8	2	1 hr	1,000	0 to 5	16	Yes	—	20 Kg	W	$\pm30^{\circ}$	Unlimited	Rugged	Fixed
97	4	2	12 hr	100	0 to 5	—	No	—	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
116	8	4	2 hr	1,000	-10 to +10	7	No	No	NR	NR	Fixed	< 2'	Everyday Abuse	Fixed
124	8	2	.5 hr	—	-10 to +10	4	No	M	NR	NR	Fixed	Unlimited	Rugged	Fixed
145	4	4	12 hr	—	0 to 5	—	D	M	NR	W	$\pm30^{\circ}$	< 2'	Frangible	Buoys
146	8	3	12 hr	100	0 to 5	8	U	M	20 Kg or NR**	W, Telep. Pole	$\pm 5^{\circ}$ $\pm15^{\circ}$	< 2'	Rugged	Buoys
235	8	4	2 hr	100	±12 Vdc	10	No	M	1 Kg	Gr, W	$\pm5^{\circ}$	< 2'	Frangible	Balloons
243	16	3	.5 hr	100	0 to 5	—	No	—	50 Kg	W	Fixed and Random	< 2' Unlimited	Rugged Frangible	Buoys Fixed
246	16	3	cts	1,000	0 to 5	—	D	D	NR	W	Fixed	Unlimited	Rugged	Fixed
256	16,100	4	3/6	300	NA	16	M	M	20 Kg NR	W NR	$\pm30^{\circ}$	Unlimited	Rugged	Buoy

* Depends on conditions.
** Depends on deployment.

TABLE 3.36

METEOROLOGY PLATFORM DATA

ID	Platform Life	User Cost Estimate	Temperature Range	Environmental Conditions																
				Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow	Burial	Vandals, Rodents, etc.	Sustained Low Temperature	Lightning	High Altitude	High Seas	Rapid Temperature Change	Rapid Depth Change	Interfacing Currents	Vibration or Impact
4	2 yr	1K	0°F Minimum	X		X	X									X Variable Sea State				
17	Indefinite	100 per year	-100° to +100°	X	X	X	X													
24	Indefinite	2K per year	0° to +120°	X		X	X 100 Kts									X 80 ft waves			X 3 Kts	
30	10 yr	—	-50° to +125°	X		X														
31	Indefinite	1K,5K	-50° to +120°		X	X	X		X	X			X							
33	Indefinite	1K	-50° to +100°			X							X	X	X					
34	2 yr	2K	-50° to +100°		X	X														
64	Indefinite	2K	-50° to + 50°			X														
66	1 yr	5K, 1K Desirable	-75° to +100°	X Storage			X	X Rime												
71	Indefinite	2K	-30° to +100°																	
84	Indefinite	1K	-50° to +100°			X	X 125 mph													
94	Indefinite	2K	-50° to +100°		X	X	X			X			X							
97	1 yr	1K	-50° to +100°			X														
116	2 yr	2K	-50° to +100°			X														
124	1 yr	500	-50° to +100°			X														
145	6 mo	1K	0° to +100°	X																
146	3 mo Replenish	5K	0° to + 50°	X		X														
235	1 yr	2K	-100° to + 50°			X	X 50-70 mph	(Operate at 0°C after coming out of -50°C storage for 11 hours)												
243	Indefinite	1K	-50° to +150°	X	X	X	X				X Rifle Shot		(Vibration X) (Impact X)							
246	Indefinite	5K	-50° to + 50°			X	X													
256	1 yr Indefinite	5K	0° to +100°	X			X				(Surface currents > 5 Kts)					X (Large accelerations > 1g)				

TABLE 3.38

OCEANOGRAPHY PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rates for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Interrogateable Platform	Position Location	Platform Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
4	16	[illegible]	1 hr	—BPS	U	U	D	—	NR	U	±30°	< 2'	Rugged	Buoy
17	4	2	24 hrs	—	—	—	D	D	—	—	—	—	Everyday Abuse	—
19	8	3	12 hrs	—	0 to 5	U	No	M	10, 100 Gr 1 Kg	G, E, O	±30°	Non-existant < 6"	Buoy Marine Animal	
21	8	3	6 hrs	—	-10 to +10	—	D	M	NR	NR	Fixed	—	Rugged	On Floating Ice
23	16	3	.5 hr	1,000	-10 to +10	—	D	—	NR	NR	Fixed ±15°	Unlimited	Rugged	Buoy Fixed
24	16	2	1 hr	—	-10 to +10	12	D	M	NR	NR	±30°	Unlimited	Rugged	Buoy Fixed
30	16	3	24 hr	—	-10 to +10	U	D	—	NR	NR	Fixed ±15°	Unlimited	Everyday Abuse	Oceanogr. Vessel
32	8	2	.5 hr	—	0 to 5	4	No	—	10, 20, 40 Kg	W, 1M³	±30°	Unlimited	Rugged	Buoys Fixed
57	8	3	1 hr	—	-10 to +10	11	D	—	NR	W	Fixed	Unlimited	Everyday Abuse	Fixed
64	8	3	1 hr	—	U	10	D	M	100 Kg	W	±15°	< 2'	Rugged	Buoys
66	4	4	1 hr	—	0 to 5	10	D	M	10 Kg	Fit in 8" Pipe	Fixed	Unlimited	Rugged	Buoys
71	16	4	cts	—	—	—	Yes	—	Portable	Trailer Mount	Random	Unlimited	Everyday Abuse	Mobile Trailer Mount
80	8	—	12 hrs	—	—	—	D	—	—	—	—	—	Rugged	Buoys
91	8	4	1 hr	100	0 to 5	<1,000	D	M	NR	NR	Random	Unlimited	Everyday Abuse	Fixed
104	16	2	1 hr	—	0 to 5	—	D	M	NR	Other	±30°	Unlimited	Rugged	Buoys Towers
137	8	4	24 hrs	—	—	—	D	M	NR	NR	Random	Unlimited	Rugged	Fixed
140	8	3	6 hrs	100	-10 to +10	20	D	—	10 Kg	E, W	Random	< 2'	Rugged	Buoys Fixed
145	4	4	12 hrs	—	0 to 5	—	D	M	NR	W	±30°	< 2'	Frangible	Buoys
146	8	3	12 hrs	100	0 to 5	8	No	M	20 Kg or NR*	W Tele. Pole	± 5° ±15°	< 2'	Rugged	Buoys
153	8	2	24 hrs	—	0 to 5	—	D	M	10 Gr NR	E, NR	±30°	Unlimited	Rugged	Animals Buoys
156	16	4	cts	10	—	31	—	—	NR	NR	—	Unlimited	Rugged	Buoys
160	4	4	24 hrs	—	—	—	No	M	NR	W	±15° Random	< 10'	Frangible	Spar Buoy
193	8	3	1 hr	—	0 to 5	—	U	M	NR	NR	±15°	Unlimited	Everyday Abuse	Buoys
243	16	3	.5 hr	100	0 to 5	—	No	—	50 Kg	W	Fixed Random	< 2' Unlimited	Rugged Frangible	Buoys Fixed
246	16	3	cts	1,000	0 to 5	—	D	D	NR	W	Fixed	Unlimited	Rugged	Fixed
250	4	—	1 hr, 1 min**	—	—	15	M	—	NR	Other	±30°	Unlimited	Rugged	Buoy
256	16,100	4	3/6 hr	300	NA	16	M	M	20 Kg NR	W, NR	±30°	Unlimited	Rugged	Buoy

* Depends on Deployment.

** During Tsunami.

TABLE 3.39

OCEANOGRAPHY PLATFORM DATA

ID	Program Life	User Cost Estimate	Environmental Conditions: Temperature Range	Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow, Snow Loads	Burial	Vandals, Rodents, etc.	Sustained Low Temperature	Lightning	High Altitude	Dry and Windy	High Seas	Rapid Temperature Change	Rapid Depth Change	Interfacing Currents	Vibration or Impact
4	2 yr	1K	0^{o}F Minimum	X		X	X										X Variable Sea state				
17	Indefinite	100 per year	$-100^{o}$to$+100^{o}$	X	X	X															
19	1 yr	100 500	0^{o} to $+100^{o}$	X														X	X		
21	Indefinite	—	$-100^{o}$to$+100^{o}$	X																	
23	Indefinite	—	$-50^{o}$to$+100^{o}$			X															
24	Indefinite	2K per year	0^{o} to$+120^{o}$	X		X	X 100 Kts										X 80 ft waves			X 3 Kts	
30	10 yr	—	$-50^{o}$to$+125^{o}$	X		X															
32	Indefinite	1K	$-100^{o}$to$+100^{o}$			X															
57	5 yr	1K	$-50^{o}$to$+100^{o}$			X															
64	Indefinite	2K	$-50^{o}$to$+50^{o}$	X																	
66	1 yr	5K, 1K Desirable	$-75^{o}$to$+100^{o}$	X Storage			X	X Rime													
71	Indefinite	2K	$-30^{o}$to$+100^{o}$																		
80	Indefinite	5K	0^{o} to$+100^{o}$	X			X														
91	Indefinite	500	$-50^{o}$to$+100^{o}$			X	(Corrosion resistant X)														
104	1 yr	2K	0^{o} to 100^{o}	X																	
137	2 yr	2K	$-50^{o}$to$+100^{o}$	X																	
140	2 yr	1K	$0^{o}$to$+100^{o}$	X	X	X															
145	6 mo	1K	$0^{o}$to$+100^{o}$	X																	
146	3 mo Peplenish	5K	$0^{o}$to$+50^{o}$	X		X															
153	Indefinite	—	$0^{o}$to$+100$	X		X	X							(Biological Fowling)			X Rough seas				
156	3 mo	5K	$0^{o}$to$+50^{o}$	X			X										X Rough seas				
160	5 yr	5K	$+50^{o}$ to $+100^{o}$	X													(Sea surface conditions in-tropics & sub-tropics)				
193	3 mo	2K	$0^{o}$to$+100^{o}$	X		X	X														
243	Indefinite	1K	$-50^{o}$to$+150^{o}$	X	X	X	X					X Rifle shot	(Vibration X) (Impact X)								
246	Indefinite	5K	$-50^{o}$to$+50^{o}$			X	X														
250	Indefinite	—	$0^{o}$to$+100^{o}$	X																	
256	1 yr Indefinite	5K	$0^{o}$to$+100^{o}$	X			X					(Surface currents > 5 Kts)					X (Large accelerations >1 Kg)				

TABLE 3.41

OTHER AREAS OF INTEREST PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rates for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Interrogatable Platform	Position Location	Platform Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
							--FISHERIES--							
4	16	2	1 hr	—	U	U	D	—	NR	U	±30°	< 2'	Rugged	Buoy
19	8	3	12 hr	—	0 to 5	U	No	M	10,100 Gr 1 Kg	G, E, O	±30° Random	Non-existant < 6"	Rugged	Buoy Marine Animal
153	8	2	24 hr	—	0 to 5	U	D	M	10 Gr NR	E, NR	±30°	Unlimited	Rugged	Animals Buoys
156	16	4	cts	10	—	—	—	—	NR	NR	—	Unlimited	Rugged	Buoys
							--ENGINEERING--							
9	8	3	—	—	—	—	No	—	NR	NR	Fixed	Unlimited	Everyday Abuse	Buoys Fixed
137	8	4	24 hrs	—	—	—	D	M	NR	NR	Random	Unlimited	Rugged	Fixed
235	8	4	24 hrs	100	±12 Vdc	10	No	M	1 Kg	Gr, W	±5°	< 2'	Frangible	Balloons
261	16	—	1,6,12, 24 hrs	—	—	—	D	NO	NR	NR	Fixed	< 6"	—	Buoys, Fixed, A/C
							--GEODESY--							
23	16	3	.5 hr	1,000	-10 to +10	—	D	—	NR	NR	Fixed ±15°	Unlimited	Rugged	Buoy Fixed
							--PHOTOGRAMMETRY--							
23	16	3	.5 hr	1,000	-10 to +10	—	D	—	NR	NR	Fixed ±15°	Unlimited	Rugged	Buoy Fixed
248	8	4	1 hr	100	-10 to +10	32	No	M	100 Gr. 100 Kg	2 ft³ E	±15° Random	Non-existant Unlimited	Everyday Abuse	Animals Fixed
							--WILD LIFE AND RANGE MANAGEMENT--							
38	8	2	1 hr	—	-10 to +10	4	—	—	100 Gr NR	O, NR	Random Fixed	< 6"	Rugged	Animals Fixed
136	8	3	1 hr	—	-10 to +10	—	D	—	10,100 Gr 1 Kg	E, W	±15°	Non-existant < 2'	Rugged	Animals Fixed
242	4	—	1 hr	—	—	—	No	M	1 Kg	Gr	±30°	< 6"	Rugged	Animal

TABLE 3.42

OTHER AREAS OF INTEREST PLATFORM DATA

ID	Platform Life	User Cost Estimate	Temperature Range	Environmental Conditions: Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow, Snow Loads	Burial	Vandals, Rodents, etc	Sustained Low Temperature	Lightning	High Altitude	Dry and Windy	High Seas	Rapid Temperature Change	Rapid Depth Change
								--FISHERIES--											
4	2 yr	1K	0°F Minimum	X		X	X										X Variable Sea state		
19	1 yr	100,500	0° to $+100^{\circ}$	X														X	X
153	Indefinite	—	0° to $+100^{\circ}$	X		X	X						(Biological Fouling)				X Rough seas		
156	3 mo	5K	0° to $+50^{\circ}$	X			X										X Rough seas		
								--ENGINEERING--											
9	1 yr	—	-100° to $+100^{\circ}$	X		X	(Must be able to withstand installation buoys, in desert areas, and arctic areas)												
137	2 yrs	2K	-50° to $+100^{\circ}$	X		X	X 50-70 mph	(operate @ 0°C after coming out of -50°C storage for 11 hours)											
235	1 yr	2K	-100° to $+50^{\circ}$			X													
261	Varying Periods	—	-50° to $+100^{\circ}$	X	X	X													
								--GEODESY--											
23	Indefinite	—	-50° to $+100^{\circ}$			X													
								--PHOTOGRAMMETRY--											
23	Indefinite	—	-50° to $+100^{\circ}$			X													
248	5 yr	—	-100° to $+100^{\circ}$			X	X			X Deep snow			X						
								--WILD LIFE AND RANGE MANAGEMENT--											
38	Indefinite	1K	-50° to $+100^{\circ}$		X														
136	5 yrs	500	-50° to $+100^{\circ}$				X											X (Diurnal)	
242	6 mo	100	0° to $+100^{\circ}$		X														

TABLE 3.43

OTHER AREAS OF INTEREST PLATFORM DATA

ID	Number of Sensors Per Platform	Decimal Precision of Data (Digits)	Synoptic Period	Bit Rates for Continuous Transmission Platforms	Analog Sensor Voltage Range	Digital Sensor Bits Per Measurement	Commandable/Interrogateable Platform	Position Location	Platform Weight	Platform Size	Platform Orientation	Platform Protrusions	Platform Construction	Platform Type
--INFORMATION/DATA MANAGEMENT--														
71	16	4	cts	—	—	—	Yes	—	Portable	Trailer Mount	Random	Unlimited	Everyday Abuse	Mobile Trailer Mount
--MICROMETEOROLOGY--														
95	>16	2	1 hr	—	Other	5	D	—	10 Kg	W	Fixed	< 6"	Rugged	Fixed
--PERMAFROST STUDIES--														
101	8	2	2 hr	—	U	U	—	—	20 Kg	W	Random	Unlimited	Rugged	Fixed
--CARTOGRAPHY--														
105	16	3	24 hrs	—	0 to 5	—	D	D	1 Kg	G	Random	Non-existant	Both	Mobile
--ZOOLOGY--														
170	8	2	1 hr	—	—	—	D	M	10 Gr, 100 Gr 1 Kg	GEOG	$\pm 15^{\circ}$	< 6"	Rugged	Animals
--PLANETARY EXPLORATION--														
235	8	4	2 hrs	100	$\pm$12 Vdc	10	No	M	1 Kg	Gr, W	$\pm 5^{\circ}$	< 2'	Frangible	Balloons
--OCEAN MINING--														
80	8	—	12 hrs	—	—	—	D	—	—	—	—	—	Rugged	Buoy

TABLE 3.44

OTHER AREAS OF INTEREST PLATFORM DATA

ID	Platform Life	User Cost Estimate	Environmental Conditions: Temperature Range	Submersion in Salt Water, Salt Spray	Submersion in Fresh Water	High Humidity	High Winds	Icing	Heavy Rains	Heavy Snow, Snow Loads	Burial	Vandals, Rodents, etc.	Sustained Low Temperature	Lightning	High Altitude	Dry and Windy	High Seas	Rapid Temperature Change	Rapid Depth Change
--INFORMATION/DATA MANAGEMENT--																			
71	Indefinite	2K	-30° to $+100^{\circ}$																
--OCEAN MINING--																			
80	Indefinite	5K	0° to $+100^{\circ}$	X			X												
--MICROMETEOROLOGY--																			
95	Indefinite	500	-50° to $+100^{\circ}$	X	X	X	X										X Rough water		
--PERMAFROST STUDIES--																			
101	5 yr	1K	-100° to $+100^{\circ}$			X	X	X Rime					X						
--CARTOGRAPHY--																			
105	1 yr	100	$+100^{\circ}$ Maximum													X			
--ZOOLOGY--																			
170	2 yrs	500	-50° to $+100^{\circ}$	X Subject to Preening															
--PLANETARY EXPLORATION--																			
235	1 yr	2K	-100° to $+50^{\circ}$			X	X 50-70 mph	(Operate @ 0°C after coming out of -50°C storage for 11 hours)											

TABLE 3.46

AGRICULTURE SYSTEM DATA

ID	Geographic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Relay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
33	D	cts	NR	.5 hr	8	3	10	100	D	—	—	—	—	—	—	1977	Indefinite
50	D	24 hr	100 KM	1 wk	8	3	—	—	—	—	—	—	—	—	—	1974	5 yr
71	D	cts	10 KM	1 hr	16	4	—	—	D	—	—	—	—	—	—	1974	1 yr Indefinite
94	D	1 hr	10 KM	1 hr	8	2	16	1000	D	—	—	—	—	—	—	1977	Indefinite
97	F	12 hr	10 KM	1 mo	4	2	—	100	No	—	—	—	—	—	—	1977	1 yr
105	D,F	24 hr	10 KM, 100 KM	1 mo	16	3	—	—	D	D	5 KM	24 hr	1 wk to 1 mo.	1 KM/hr	Random	1977	1 yr
112	D	24 hr	100 KM	1 wk	16	3	14	—	No	—	—	—	—	—	—	1977	2 yr
114	D	6 hr	10 KM	1 wk	16	4	—	100	D	D	1 KM	24 hr	24 hr	10 KM/hr	Random	1980	Indefinite
125	D	6 hr	100 KM	1 mo	8	3	—	100	No	M	2 KM	—	—	—	—	1974	5 yr
132	D	6 hr	100 KM	1 wk	8	3	8	—	—	—	—	—	—	—	—	1974	2 yr
133	D	24 hr	100 KM	12 hr	4	2	—	—	No	—	—	—	—	—	—	1977	2 yr
154	D	12 hr	100 KM	2-3 hr	16	3	8	100	D	—	—	—	—	—	—	1974	2 yr
236	D	12 hr	10 KM	1 mo	8	3	—	—	No	—	—	—	—	—	—	1977	2 yr
243	D	5 hr	10 KM	ASAP 1wk- 1mo	16	3	—	100	No	—	—	—	—	—	—	1974	Indefinite

*10 KM = 6.2 Mi

100 KM = 62 Mi

TABLE 3.47

ECOLOGY SYSTEM DATA

ID	Geographic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Delay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
4	D	1 hr	10 KM	12 hr	16	2	U	—	D	—	—	—	—	—	—	1980	2 yr
17	ABCDEF GHIJK	24 hr	100 KM	12 hr	4	2	—	—	D	D	5 KM	24 hr	24 hr	—	—	1977	Indefinite
19	CDE	12 hr	10 KM	1 wk	8	3	U	—	No	M	2 KM	12 hr	1 wk	10 KM/hr	Random	1977	1 yr
30	D	24 hr	10 KM	1 wk	16	3	U	—	D	—	—	—	—	—	—	1974	10 yr
31	D	12/24 hr	10 KM 100 KM	1 hr	8/16	2,3,4	15/48	—	D	—	—	—	—	—	—	1977	Indefinite
32	CDEI	.5 hr	10 KM	.5 hr	8	2	4	—	No	—	—	—	—	—	—	1980	Indefinite
33	D	cts	NR	.5 hr	8	3	10	100	Yes	—	—	—	—	—	—	1977	Indefinite
38	D	1 hr	10 KM	1 wk	8	2	4	—	—	—	—	—	—	—	—	1974	Indefinite
57	D	1 hr	10 KM	12 hr	8	3	11	—	D	—	—	—	—	—	—	1980	5 yr
63	CDE	6 hr	10 KM	1 hr	16	4	U	—	No	M	1 KM	6 hr	1 hr	10 KM/hr	Random	1977	5 yr
71	D	cts	10 KM	1 hr	16	4	—	—	Yes	—	—	—	—	—	—	1974	1 yr Indefinite
73	D	1 wk	100 KM	1 mo.	8	2	—	100	D	M	1 KM	1 wk	1 wk	—	—	1977	1 yr
91	D	1 hr	5 KM	12 hr	8	4	<1000	100	D	M	1 KM	1 hr	.5 hr	1 KM/hr	Constant	1977	Indefinite
94	D	1 hr	10 KM	1 hr	8	2	16	1000	Yes	—	—	—	—	—	—	1977	Indefinite
95	D	1 hr	10 KM	1 wk	>16	2	5	—	D	—	—	—	—	—	—	1977	Indefinite
97	F	12 hr	10 KM	1 mo	4	2	—	100	No	—	—	—	—	—	—	1977	1 yr
101	D	2 hr	10 KM	1 wk	8	2	U	—	—	—	—	—	—	—	—	1974	5 yr
105	D,F	24 hr	10 KM 100 KM	1 mo	16	3	—	—	D	D	5 KM	24 hr	1 wk to 1 mo	1 KM/hr	Random	1977	1 yr
114	D	6 hr	10 KM	1 wk	16	4	—	100	D	D	1 KM	24 hr	24 hr	10 KM/hr	Random	1980	Indefinite
118	D	24 hr	100 KM	12 hr	8	2	—	—	No	—	—	—	—	—	—	1974	2 yr
132	D	6 hr	100 KM	1 wk	8	3	8	—	—	—	—	—	—	—	—	1974	2 yr
136	D	1 hr	10 KM	1 wk	8	3	—	—	D	—	—	—	—	—	—	1977	5 yr
140	D	6 hr	5 KM	12 hr	8	3	20	100	D	—	—	—	—	—	—	1977	2 yr
146	ACEF GJKL	12 hr	400-600 KM	12 hr	8	3	8	100	U	M	1,2,5 KM	6,12hrs	2,12 hrs	1,10KM/hr	Constant	1974 1977	3 mo
154	D	12 hr	100 KM	2-3 hr	16	3	8	100	D	—	—	—	—	—	—	1974	2 yr
170	ACEGHI JKL	1 hr	100 KM	1 mo	8	2	—	—	D	M	1 KM	1 hr	24 hr	100KM/hr	Random	1977	2 yr
193	D	1 hr	10 KM	1 wk	8	3	—	—	U	M	1 KM	1 hr	1 wk	10KM/hr	Random	1977	3 mo
236	D	12 hr	10 KM	1 mo	8	3	—	—	No	—	—	—	—	—	—	1977	2 yr
242	D	1 hr	10 KM	1 wk	4	—	—	—	U	M	1 KM	1 hr	1 wk	1KM/hr	Random	1980	6 mo
243	D	5 hr	10 KM	ASAP 1wk- 1mo	16	3	—	100	No	—	—	—	—	—	—	1974	Indefinite

TABLE 3.48

ENVIRONMENTAL QUALITY SYSTEM DATA

ID	Geographic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Delay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
4	D	1 hr	10 KM	12 hr	16	2	U	—	D	—	—	—	—	—	—	1980	2 yr
17	ABCDEF GHIJK	24 hr	100 KM	12 hr	4	2	—	—	D	D	5 KM	24 hr	24 hr	—	—	1977	Indefinite
19	CDE	12 hr	10 KM	1 wk	8	3	U	—	No	M	2 KM	12 hr	1 wk	Random	10 KM/hr	1977	1 yr
23	D	.5 hr	10 KM	12 hr	16	3	—	1,000	D	—	—	—	—	—	—	1974	Indefinite
30	D	24 hr	10 KM	1 wk	16	3	U	—	D	—	—	—	—	—	—	1974	10 yr
31	D	12/24 hr	10 KM 100 KM	1 hr	8/16	2, 3, 4	15/48	—	D	—	—	—	—	—	—	1977	Indefinite
32	CDEI	.5 hr	10 KM	.5 hr	8	2	4	—	No	—	—	—	—	—	—	1980	Indefinite
33	D	cts	NR	.5 hr	8	3	10	100	Yes	—	—	—	—	—	—	1977	Indefinite
57	D	1 hr	10 KM	12 hr	8	3	11	—	D	—	—	—	—	—	—	1980	5 yr
71	D	cts	10 KM	1 hr	16	4	—	—	Yes	—	—	—	—	—	—	1974	1 yr Indefinite
73	D	1 wk	100 KM	1 mo	8	2	—	100	D	M	1 KM	1 wk	1 wk	—	—	1977	1 yr
84	D	1,2,6 hr	<10 KM	1 hr	4	2	16	100	D	—	—	—	—	—	—	1980	Indefinite
91	D	1 hr	5 KM	12 hr	8	4	<1,000	100	D	M	1 KM	1 hr	.5 hr	1 KM/hr	Constant	1977	Indefinite
94	D	1 hr	10 KM	1 hr	8	2	16	1,000	Yes	—	—	—	—	—	—	1977	Indefinite
95	D	1 hr	10 KM	1 wk	>16	2	5	—	D	—	—	—	—	—	—	1977	Indefinite
101	D	2 hr	10 KM	1 wk	8	2	U	—	—	—	—	—	—	—	—	1974	5 yr
105	DF	24 hr	10 KM 100 KM	1 mo	16	3	—	—	D	D	5 KM	24 hr	1 wk to 1 mo	1 KM/hr	Random	1977	1 yr
114	D	6 hr	10 KM	1 wk	16	4	—	100	D	D	1 KM	24 hr	24 hr	10 KM/hr	Random	1980	Indefinite
116	D	2 hr	10 KM	1 wk	8	4	7	1,000	No	No	—	—	—	—	—	1974	2 yr
118	D	24 hr	100 KM	12 hr	8	2	—	—	No	—	—	—	—	—	—	1974	2 yr
125	D	6 hr	100 KM	1 mo	8	3	—	100	No	M	2 KM	—	—	—	—	1974	5 yr
132	D	6 hr	100 KM	1 wk	8	3	8	—	—	—	—	—	—	—	—	1974	2 yr
136	D	1 hr	10 KM	1 wk	8	3	—	—	D	—	—	—	—	—	—	1977	5 yr
140	D	6 hr	5 KM	12 hr	8	3	20	100	D	—	—	—	—	—	—	1977	2 yr
146	ACEF GJKL	12 hr	400-600 KM	12 hr	8	3	8	100	U	M	1, 2, 5 KM	6, 12 hr	2, 12 hr	1, 10 KM/hr	Constant	1974 1977	3 mo Replenish
154	D	12 hr	100 KM	2-3 hr	16	3	8	100	D	—	—	—	—	—	—	1974	2 yr
193	D	1 hr	10 KM	1 wk	8	3	—	—	U	M	1 KM	1 hr	1 wk	10 KM/hr	Random	1977	3 mo
235	GHIJK	2 hr	Random	1 hr	8	4	10	100	No	M	5 KM	2 hr	1 hr	100 KM/hr	Random	1977	1 yr
236	D	12 hr	10 KM	1 mo	8	3	—	—	No	—	—	—	—	—	—	1977	2 yr
243	D	.5 hr	10 KM	ASAP 1wk/1 mo	16	3	—	100	No	—	—	—	—	—	—	1974	Indefinite
246	ABCDEF GHIJKL	cts	10 KM	1 mo	16	3	—	1,000	D	D	1 KM	24 hr	24 hr	100 KM/hr	Constant	1980	Indefinite
248	D	1 hr	10 KM	1 wk	8	4	32	100	No	M	1 KM	.5 hr	1 wk	10 KM/hr	Random	1974	5 yr
256	ACDE	3/6 hr	100 KM	.5 hr	16, 100	4	16	300	M	M	2 KM	On Demand 6 hr	.5 hr	10 KM/hr	Random	1980	1 yr Indefinite

TABLE 3.49

FORESTRY SYSTEM DATA

ID	Geographic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Delay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
31	D	12/24 hr	10 KM 100 KM	1 hr	8/16	2,3 4	15/48	—	D	—	—	—	—	—	—	1977	Indefinite
32	CDEI	.5 hr	10 KM	.5 hr	8	2	4	—	No	—	—	—	—	—	—	1980	Indefinite
50	D	24 hr	100 KM	1 wk	8	3	—	—	—	—	—	—	—	—	—	1974	5 yr
55	D	12 hr	1 KM	12 hr	16	2	5	—	No	—	—	—	—	—	—	1974	2 yr
71	D	cts	10 KM	1 hr	16	4	—	—	Yes	—	—	—	—	—	—	1974	1 yr Indefinite
94	D	1 hr	10 KM	1 hr	8	2	16	1,000	Yes	—	—	—	—	—	—	1977	Indefinite
95	D	1 hr	10 KM	1 wk	>16	2	5	—	D	—	—	—	—	—	—	1977	Indefinite
101	D	2 hr	10 KM	1 wk	8	2	U	—	—	—	—	—	—	—	—	1974	5 yr
114	D	6 hr	10 KM	1 wk	16	4	—	100	D	D	1 KM	24 hr	24 hr	10 KM/hr	Random	1980	Indefinite
116	D	2 hr	10 KM	1 wk	8	4	7	1,000	No	No	—	—	—	—	—	1974	2 yr
118	D	24 hr	100 KM	12 hr	8	2	—	—	No	—	—	—	—	—	—	1974	2 yr
132	D	6 hr	100 KM	1 wk	8	3	8	—	—	—	—	—	—	—	—	1974	2 yr
136	D	1 hr	10 KM	1 wk	8	3	—	—	D	—	—	—	—	—	—	1977	5 yr
243	D	.5 hr	10 KM	ASAP 1 wk/1 mo	16	3	—	100	No	—	—	—	—	—	—	1974	Indefinite
248	D	1 hr	10 KM	1 wk	8	4	32	100	No	M	1 KM	.5 hr	1 wk	10 KM/hr	Random	1974	5 yr

TABLE 3.50

GEOLOGY SYSTEM DATA

ID	Geographic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Delay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
17	ABCDEF GHIFK	24 hr	100 KM	12 hr	4	2	—	—	D	D	5 KM	24 hr	24 hr	—	—	1977	Indefinite
30	D	24 hr	10 KM	1 wk	16	3	U	—	D	—	—	—	—	—	—	1974	10 yr
32	CDEI	.5 hr	10 KM	.5 hr	8	2	4	—	No	—	—	—	—	—	—	1980	Indefinite
33	D	cts	NR	.5 hr	8	3	10	100	Yes	—	—	—	—	—	—	1977	Indefinite
71	D	cts	10 KM	1 hr	16	4	—	—	Yes	—	—	—	—	—	—	1974	1 yr Indefinite
91	D	1 hr	5 KM	12 hr	8	4	<1,000	100	D	M	1 KM	1 hr	.5 hr	1 KM/hr	Constant	1977	Indefinite
94	D	1 hr	10 KM	1 hr	8	2	16	1,000	Yes	—	—	—	—	—	—	1977	Indefinite
95	D	1 hr	10 KM	1 wk	>16	2	5	—	D	—	—	—	—	—	—	1977	Indefinite
112	D	24 hr	100 KM	1 wk	16	3	14	—	No	—	—	—	—	—	—	1977	2 yr
116	D	2 hr	10 KM	1 wk	8	4	7	1,000	No	No	—	—	—	—	—	1974	2 yr
125	D	6 hr	100 KM	1 mo	8	3	—	100	No	M	2 KM	—	—	—	—	1974	5 yr
140	D	6 hr	5 KM	12 hr	8	3	20	100	D	—	—	—	—	—	—	1977	2 yr
154	D	12 hr	100 KM	2-3 hr	16	3	8	100	D	—	—	—	—	—	—	1974	2 yr
193	D	1 hr	10 KM	1 wk	8	3	—	—	U	M	1 KM	1 hr	1 wk	10 KM/hr	Random	1977	3 mo
243	D	.5 hr	10 KM	ASAP 1 wk/1 mo	16	3	—	100	No	—	—	—	—	—	—	1974	Indefinite

TABLE 3.51

HYDROLOGY SYSTEM DATA

ID	Geographic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Relay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
17	ABCDEF GHIJK	24 hr	100 KM	12 hr	4	2	—	—	D	D	5 KM	24 hr	24 hr	—	—	1977	Indefinite
30	D	24 hr	10 KM	1 wk	16	3	U	—	D	—	—	—	—	—	—	1974	Indefinite
31	D	12/24 hr	10 KM 100 KM	1 hr	8/16	2,3,4	15/48	—	D	—	—	—	—	—	—	1977	Indefinite
32	CDEI	.5 hr	10 KM	.5 hr	8	2	4	—	No	—	—	—	—	—	—	1980	Indefinite
33	D	cts	NR	.5 hr	8	3	10	100	Yes	—	—	—	—	—	—	1977	Indefinite
34	D	24 hr	100 KM	12 hr	4	4	—	—	—	—	—	—	—	—	—	1974	2 yr
50	D	24 hr	100 KM	1 wk	8	3	—	—	—	—	—	—	—	—	—	1974	5 yr
57	D	1 hr	10 KM	12 hr	8	3	11	—	D	—	—	—	—	—	—	1980	5 yr
71	D	cts	10 KM	1 hr	16	4	—	—	Yes	—	—	—	—	—	—	1974	1 yr Indefinite
73	D	1 wk	100 KM	1 mo	8	2	—	100	D	M	1 KM	1 wk	1 wk	—	—	1977	1 yr
84	D	1,2,6 hr	<10 KM	1 hr	4	2	16	100	D	—	—	—	—	—	—	1980	Indefinite
91	D	1 hr	5 KM	12 hr	8	4	<1000	100	D	M	1 KM	1 hr	.5 hr	1 KM/hr	Constant	1977	Indefinite
94	D	1 hr	10 KM	1 hr	8	2	16	1000	Yes	—	—	—	—	—	—	1977	Indefinite
95	D	1 hr	10 KM	1 wk	>16	2	5	—	D	—	—	—	—	—	—	1977	Indefinite
97	F	12 hr	10 KM	1 mo	4	2	—	100	No	—	—	—	—	—	—	1977	1 yr
101	D	2 hr	10 KM	1 wk	8	2	U	—	—	—	—	—	—	—	—	1974	5 yr
112	D	24 hr	100 KM	1 wk	16	3	14	—	No	—	—	—	—	—	—	1977	2 yr
116	D	2 hr	10 KM	1 wk	8	4	7	1000	No	No	—	—	—	—	—	1974	2 yr
124	BDFI	.5 hr	100 KM	.5 hr	8	2	4	—	No	M	2 KM	12 hr	.5 hr	—	—	1980	1 yr
135	D	2 hr	100 KM	Varies @Sensor	8	3	4	—	D	—	—	—	—	—	—	1974	Indefinite
137	—	24 hr	100 KM	12 hr	8	4	—	—	D	M	1 KM	1 hr	24 hr	—	—	1974	2 yr
154	D	12 hr	100 KM	2-3 hr	16	3	8	100	D	—	—	—	—	—	—	1974	2 yr
243	D	.5 hr	10 KM	ASAP 1wk-1mo	16	3	—	100	No	—	—	—	—	—	—	1974	Indefinite
246	ABCDEF GHIJKL	cts	10 KM	1 mo	16	3	—	1000	D	D	1 KM	24 hr	24 hr	100 KM/hr	Constant	1980	Indefinite

TABLE 3.52

METEOROLOGY SYSTEM DATA

ID	Graphic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Delay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
4	D	1 hr	100 KM	12 hr	16	2	U	—	D	—	—	—	—	—	—	1980	2 yr
17	ABCDEF GHIJK	24 hr	100 KM	12 hr	4	2	—	—	D	D	5 KM	24 hr	24 hr	—	—	1977	Indefinite
24	CH	1 hr	100 KM	12 hr	16	2	12	—	D	M	2 KM	1,2 hr	24 hr	10 KM/hr	—	1974	Indefinite
30	D	24 hr	10 KM	1 wk	16	3	U	—	D	—	—	—	—	—	—	1974	10 yr
31	D	12/ 24 hr	10 KM 100 KM	1 hr	8/16	2,3, 4	15/48	—	D	—	—	—	—	—	—	1977	Indefinite
33	D	cts	NR	.5 hr	8	3	10	100	Yes	—	—	—	—	—	—	1977	Indefinite
34	D	24 hr	100 KM	12 hr	4	4	—	—	—	—	—	—	—	—	—	1974	2 yr
64	A	1 hr	100 KM	12 hr	8	3	10	—	D	M	10 KM	1 hr	12 hr	1 KM/hr	Constant	1977	Indefinite
66	A	1 hr	100 KM	12 hr	4	4	10	—	D	M	5 KM	1 hr	12 hr	1 KM/hr	Random	1974	1 yr
71	D	cts	10 KM	1 hr	16	4	—	—	Yes	—	—	—	—	—	—	1974	1 yr Indefinite
84	D	1,2,6 hr	<10 KM	1 hr	4	2	16	100	D	—	—	—	—	—	—	1980	Indefinite
94	D	1 hr	10 KM	1 hr	8	2	16	1,000	Yes	—	—	—	—	—	—	1977	Indefinite
97	F	12 hr	10 KM	1 mo	4	2	—	100	No	—	—	—	—	—	—	1977	1 yr
116	D	2 hr	10 KM	1 wk	8	4	7	1,000	No	No	—	—	—	—	—	1974	2 yr
124	BDFI	.5 hr	100 KM	.5 hr	8	2	4	—	No	M	2 KM	12 hr	.5 hr	—	—	1980	1 yr
145	DE	12 hr	10 KM	1 wk	4	4	—	—	D	M	2 KM	12 hr	1 wk	10 KM/hr	Random	1974	6 mo
146	ACEFG JKL	12 hr	400~600 KM	12 hr	8	3	8	100	U	M	1,2 5 KM	6,12 hr	2,12 hr	1,10 KM/hr	Constant	1974 1977	3 mo
235	GHIJK	2 hr	Random	1 hr	8	4	10	100	No	M	5 KM	2 hr	1 hr	100 KM/hr	Random	1977	1 yr
243	D	.5 hr	10 KM	ASAP 1 wk/1 mo	16	3	—	100	No	—	—	—	—	—	—	1974	Indefinite
246	ABCDEF GHIFKL	cts	10 KM	1 mo	16	3	—	1,000	D	D	1 KM	24 hr	24 hr	100 KM/hr	Constant	1980	Indefinite
256	ACDE	3/6 hr	100 KM	.5 hr	16,100	4	16	300	M	M	2 KM	On Demand 6 hr	.5 hr	10 KM/hr	Random	1980	1 yr Indefinite

TABLE 3.53

OCEANOGRAPHY SYSTEM DATA

ID	Geographic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Delay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
4	D	1 hr	10 KM	12 hr	16	2	U	—	D	—	—	—	—	—	—	1980	2 yr
17	ABCDEF GHIJK	24 hr	100 KM	12 hr	4	2	—	—	D	D	5 KM	24 hr	24 hr	—	—	1977	Indefinite
19	CDE	12 hr	10 KM	1 wk	8	3	U	—	No	M	2 KM	12 hr	1 wk	10 KM/hr	Random	1977	1 yr
21	ADL	6 hr	10 KM	1 hr	8	3	—	—	D	M	1 KM	6 hrs	1 hr	10 KM/hr	Random	1974	Indefinite
23	D	.5 hr	10 KM	12 hr	16	3	—	1,000	D	—	—	—	—	—	—	1974	Indefinite
24	CH	1 hr	100 KM	12 hr	16	2	12	—	D	M	2 KM	1.2 hr	24 hr	10 KM/hr	—	1974	Indefinite
30	D	24 hr	10 KM	1 wk	16	3	U	—	D	—	—	—	—	—	—	1974	10 yr
32	CDEI	.5 hr	10 KM	.5 hr	8	2	4	—	No	—	—	—	—	—	—	1980	Indefinite
57	D	1 hr	10 KM	12 hr	8	3	11	—	D	—	—	—	—	—	—	1980	5 yr
64	A	1 hr	100 KM	12 hr	8	3	10	—	D	M	10 KM	1 hr	12 hr	1 KM/hr	Constant	1977	Indefinite
66	A	1 hr	100 KM	12 hr	4	4	10	—	D	M	5 KM	1 hr	12 hr	1 KM/hr	Random	1974	1 yr
71	D	cts	10 KM	1 hr	16	4	—	—	Yes	—	—	—	—	—	—	1974	1 yr Indefinite
80	CH	12 hr	10 KM	12 hr	8	—	—	—	D	—	—	—	—	—	—	1980	Indefinite
91	D	1 hr	5 KM	12 hr	8	4	<1,000	100	D	M	1 KM	1 hr	.5 hr	1 KM/hr	Constant	1977	Indefinite
104	D	12 hr	10 KM	12 hr	16	2	—	—	D	M	1 KM	2 hr	12 hr	1 KM/hr	Constant	1977	1 yr
137	—	24 hr	100 KM	12 hr	8	4	—	—	D	M	1 KM	1 hr	24 hr	—	—	1974	2 yr
140	D	6 hr	5 KM	12 hr	8	3	20	100	D	—	—	—	—	—	—	1977	2 yr
145	DE	12 hr	10 KM	1 wk	4	4	—	—	D	M	2 KM	12 hr	1 wk	10 KM/hr	Random	1974	6 mo
146	ACEFG JKL	12 hr	400~600 KM	12 hr	8	3	8	100	U	M	1,2 5 KM	6,12 hr	2,12 hr	1,10 KM/hr	Constant	1974 1977	3 mo
153	CH	24 hr	100 KM	12 hr	8	2	—	—	D	M	5 KM	24 hr	24 hr	10 KM/hr	Random	1974	Indefinite
156	D	cts	5 KM	24 hr	16	4	31	10	—	—	—	—	—	—	—	1974	3 mo.
160	CH	24 hr	—	1 wk	4	4	—	—	No	M	10 KM	24 hr	24 hr	10 KM/hr	Random	1977	5 yr
193	D	1 hr	10 KM	1 wk	8	3	—	—	U	M	1 KM	1 hr	1 wk	10 KM/hr	Random	1977	3 mo
243	D	.5 hr	10 KM	ASAP 1 wk/1 mo	16	3	—	100	No	—	—	—	—	—	—	1974	Indefinite
246	ABCDEF GHIJKL	cts	10 KM	1 mo	16	3	—	1,000	D	D	1 KM	24 hr	24 hr	100 KM/hr	Constant	1980	Indefinite
250	CH	1 hr 1 min	1,000 KM	12 hr cts	4	—	15	—	M	—	—	—	—	—	—	1977	Indefinite
256	ACDE	3/6 hr	100 KM	.5 hr	16,100	4	16	300	M	M	2 KM		On Demand 6 hr	.5 hr	Random	1980	1 yr Indefinite

TABLE 3.54

OTHER AREAS OF INTEREST SYSTEM DATA

ID	Geographic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Delay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
--FISHERIES--																	
4	D	1 hr	10 KM	12 hr	16	2	U	—	D	—	—	—	—	—	—	1980	2 yr
19	CDE	12 hr	10 KM	1 wk	8	3	U	—	No	M	2 KM	12 hr	1 wk	10 KM/hr	Random	1977	1 yr
153	CH	24 hr	100 KM	12 hr	8	2	—	—	D	M	5 KM	24 hr	24 hr	10 KM/hr	Random	1974	Indefinite
156	D	cts	5 KM	24 hr	16	4	31	10	—	—	—	—	—	—	—	1974	3 mo
--ENGINEERING--																	
9	D	—	Unknown	—	8	3	—	—	No	—	—	—	—	—	—	1974	1 yr
137	—	24 hr	100 KM	12 hr	8	4	—	—	D	M	1 KM	1 hr	24 hr	—	—	1974	2 yr
235	GHIJK	2 hr	Random	1 hr	8	4	10	100	No	M	5 KM	2 hr	1 hr	100 KM/hr	Random	1977	1 yr
261	—	1,6,12, 24 hr	No Minimum	16	—	—	—	—	D	No	—	—	—	—	—	Unknown	Varying Periods
--GEODESY--																	
23	D	.5 hr	10 KM	12 hr	16	3	—	1,000	D	—	—	—	—	—	—	1974	Indefinite
--PHOTOGRAMMETRY--																	
23	D	.5 hr	10 KM	12 hr	16	3	—	1,000	D	—	—	—	—	—	—	1974	Indefinite
248	D	1 hr	10 KM	1 wk	8	4	32	100	No	M	1 KM	.5 hr	1 wk	10 KM/hr	Random	1974	5 yr
--WILD LIFE AND RANGE MANAGEMENT--																	
38	D	1 hr	10 KM	1 wk	8	2	4	—	—	—	—	—	—	—	—	1974	Indefinite
136	D	1hr	10 KM	1 wk	8	3	—	—	D	—	—	—	—	—	—	1977	5 yr
242	D	1 hr	10 KM	1 wk	—	—	—	—	U	M	1 KM	1 hr	1 wk	1 KM/hr	Random	1980	6 mo

TABLE 3.55

OTHER AREAS OF INTEREST SYSTEM DATA

ID	Geographic Area	Synoptic Period	Platform Separation	DCP Data Delay	Number of Sensors Per Platform	Decimal Precision of Data	Digital Sensor Bits Per Measurement	Bit Rate for Continuous Transmission	Commandable/ Interrogatable	Position Location Required	Position Location Accuracy	Position Location Rate	Position Location Data Delay	Platform Velocity	Platform Acceleration	Time of Implementation	Duration of Operation
						--INFORMATION/DATA MANAGEMENT--											
71	D	cts	10 KM	1 hr	16	4	—	—	Yes	—	—	—	—	—	—	1974	1 yr Indefinite
							--OCEAN MINING--										
80	CH	12 hr	10 KM	12 hr	8	—	—	—	D	—	—	—	—	—	—	1980	Indefinite
							--MICROMETEOROLOGY--										
95	D	1 hr	10 KM	1 wk	>16	2	5	—	D	—	—	—	—	—	—	1977	Indefinite
							--PERMAFROST STUDIES--										
101	D	2 hr	10 KM	1 wk	8	2	U	—	—	—	—	—	—	—	—	1974	5 yr
							--CARTOGRAPHY--										
105	DF	24 hr	10 KM 100 KM	1 mo	16	3	—	—	D	D	5 KM	24 hr	1 wk to 1 mo	1 KM/hr	Random	1977	1 yr
							--ZOOLOGY--										
170	ACEGHI JKL	1 hr	100 KM	1 mo	8	2	—	—	D	M	1 KM	1 hr	24 hr	100 KM/hr	Random	1977	2 yr
							--PLANETARY EXPLORATION--										
235	GHIJK	2 hr	Random	1 hr	8	4	10	100	No	M	5 KM	2 hr	1 hr	100 KM/hr	Random	1977	1 yr

3.3 GRAPHICAL DATA

In this section the results of the survey are presented in graphical form with relevant constraints on the data noted. The actual computer tabulations from which the graphs were made are given in the Task 4 report under this contract. The graphs are organized into two major areas. These are the platform data and the system data. This was done to ease the correlation of the data with the user data collection platform requirements and the user collection system requirements.

3.3.1 General

Before proceeding further, it is relevant to point out certain general characteristics of the data so that misinterpretation is avoided.

The data base consists of the data in 62 completed or partially completed questionnaires. For various reasons, the respondees left certain questions blank. To account for this in the presentation of the data, the "Response Factor" is used. The Response Factor is defined as the ratio of the number of respondees who answered a particular question to the total number of respondees (62).

In question A1 of the questionnaire, the user was asked to associate a specific number of data collection platforms with a specific geographic area. Ten of the respondees did not indicate a specific number of platforms and three of these ten did not indicate geographic areas. These ten respondees were arbitrarily assigned zero platforms. Also, the situation, necessitated the use of two numbers for user response. These were:

1. The number of respondees who indicated a specific number of platforms

2. The total number of respondees who answered a particular part of a question.

Having these two numbers tabulated along with the data gives an indication of the possibility of more platforms being associated with a particular answer.

Another characteristic of the data requiring special treatment was multiple answers to the same question. For example, several respondees indicated an interest in more than one synoptic period. The impact on the data is twofold. First of all, if one adds the responses to all parts of a particular question it can exceed 62 (the total number of respondees) with a 100% Response Factor (e.g., synoptic period). If the Response Factor is less than 100%, the total number of responses to the question may or may not equal the previously mentioned sum. The second impact is on the number of platforms assigned to a particular answer. If the respondee indicated more than one answer to a particular question and did not specify the distribution of platforms among the answers, his total number of platforms was evenly divided among the answers*.

Unfortunately these idiosyncracies in the data can lead to confusion and misinterpretation if not completely understood. To facilitate a complete understanding of the data, Appendix A is provided. It is recommended that the reader study Appendix A prior to interpreting the data tabulations. Appendix A provides a simplified data tabulation and points out possible areas of misinterpretation (e.g., in Table 3.63 adding percentages of users yields a number greater than 100% and adding the same percentages in Table 3.61 yields a number less than 100%).

The data graphs and tables are generally self-explanatory. The question as stated in the questionnaire is given on the graph to avoid misinterpretation. Also, to indicate the relatively large number of platforms associated with two of the respondees, cross-hatching is used to identify their contribution to the data.

3.3.2 Platform Data

In this section survey data directly related to data collection platform requirements will be presented. The data will be presented according to the following organization:

- Communications/Data Collection Capability
  - Number of Data Collection Platforms per User
  - Number of Sensors per Platform
  - Decimal Precision of the Data
  - Analog Sensor - Voltage Range
  - Digital Sensor - Bits per Measurement
  - Synoptic Period
  - Bit Rate for Continuous Transmission Platforms
  - Commandable/Interrogateable Platforms.
- Position Location
  - Requirement for Position Location

---

*If the division was uneven, the excess platforms were arbitrarily assigned to various answers.

- Environmental Conditions
  - Temperature Range
  - Other Environmental Conditions
- Platform Physical Characteristics
  - Platform Weight
  - Platform Size
  - Platform Orientation
  - Platform Protrusions
  - Platform Construction
- Platform Type
- Platform Reliability
  - Expected Platform Life
- Platform Cost
  - User Cost Estimate.

3.3.2.1 Number of Data Collection Platforms Per User

For purposes of sizing future systems and relating number of system users to number of platforms, the distribution of platforms among the respondees was examined. Table 3.56 summarizes all of the information. In Table 3.56, the number of platforms (N_P) and the number of respondees who stated a particular number of platforms (N_R) are examined. As shown in the table, of the 62 respondees 52 together indicated 11,260 platforms. Of these 52, 2 together indicated 8,000 platforms leaving 3,260 distributed among the remaining 50 respondees. Thus a very small number of respondees contribute disproportionately to the total number of platforms. Table 3.57 indicates clearly the overall relationship between the Number of Respondees and the Number of Platforms.

The conclusion from Table 3.57 is that the Number of Platforms and Number of Respondees are only slightly correlated. Thus in interpreting the data, both numbers should be considered necessary. A way to clarify this relative independence is to realize that 71% of the platforms (N_P = 8,000) resulting from 3.21% of the users (N_R=2). One might consider removing these two from the data base to make the data more uniform. This possibility was considered and it was determined that the respondee

TABLE 3.56

PLATFORM DISTRIBUTION AMONG RESPONDEES

N_P	N_R	$N_P.N_R$	Cumulative			
			N_R	% N_R	N_P	% N_P
0	10	0	10	0	0	0
1	1	1	11	17.7	1	.0009
2	2	4	13	20.5	5	.0445
3	3	9	16	25.8	15	.1245
4	2	8	18	29.0	22	.1960
5	5	25	23	37.0	47	.4170
6	3	18	26	42.0	65	.5780
7	1	7	27	43.5	72	.6400
8	2	16	29	46.7	88	.7830
9	1	9	30	48.4	97	.8640
10	5	50	35	56.5	147	1.3100
12	2	24	37	59.5	171	1.5200
15	1	15	38	61.2	126	1.6500
16	1	16	39	63.0	202	1.8000
18	1	18	40	64.5	220	1.9600
20	1	20	41	66.0	240	2.1400
25	2	50	43	69.2	290	2.5800
30	3	90	46	74.0	380	3.3800
31	1	31	47	75.6	411	3.6600
35	1	35	48	77.3	446	3.9600
50	1	50	49	79.0	496	4.4200
80	1	80	50	80.5	576	5.1300
90	1	90	51	82.0	666	5.9200
95	1	95	52	83.6	761	6.7700
100	1	100	53	85.2	861	7.6600
144	1	144	54	86.8	1,005	8.9500
210	1	210	55	87.4	1,215	10.8000
245	1	245	56	89.0	1,460	13.0000
300	3	900	59	94.9	2,360	21.0000
900	1	900	60	96.5	3,260	29.0000
3,000	1	3,000	61	98.3	6,260	55.6000
5,000	1	5,000	62	100.0	11,260	100.0000
Totals	62	11,260				

TABLE 3.57

PERCENTAGE OF RESPONDEES ($N_R\%$) VS

PERCENTAGE OF PLATFORMS ($N_P\%$)

$N_R\%$	$N_P\%$
20.5	.0445
48.4	.8640
75.6	3.6600
89.0	13.0000
96.5	29.0000
98.3	55.6000

indicating 3,000 platforms had a valid requirement and should not be eliminated from the data. Regarding the respondee who specified 5,000 platforms, it was determined that his requirement should be considered doubtful. In any event, the data for these two respondees is clearly identified where it appears so that reasonable interpretations can be made.

As a final indication of the nature of the platform distribution among the users, Figure 3.1 gives a cummulative distribution of the number of platforms per user. This distribution can be used to forecast platform distributions with certain likelihoods.

3.3.2.2 Number of Sensors per Platform

In the questionnaire, the respondee was asked to indicate his requirement for sensors. Note that the term sensor refers to a particular transducer sensing a particular parameter. Data Collection Platforms can clearly accommodate more than one sensor. The results of the question are shown in Figure 3.2. As indicated 17.74% of the users (11.08% of the platforms*) indicated 4 sensors or less. 51.61% of the users (77.2% of the platforms) indicated 8 sensors or less. 30.64% of the users (11.18% of the platforms) indicated 16 sensors or less. 3.22% of the users (.52% of the platforms) indicated a number of sensors other than those given in the questionnaire. These "other" values were 20 and 100.

All of the users answered the question yielding a Response Factor of 100%.

3.3.2.3 Decimal Precision of Data

In any scientific measurement, the desired accuracy of the measured parameters (or the resultant accuracy) is always specified. For this reason, the potential data collection system users were asked to indicate the accuracy their measurements required. Such a requirement effects the design of data collection platforms (DCP) and is therefore relevant. The effect on the DCP design is summarized in Table 3.58. In Table 3.58, the accuracy

---

* In the text and tables which follow, the percentage of platforms given is relative to a 6260 total which excludes the user with 5,000 platforms. On the other hand, the percentage relative to 11,260 platforms which includes the user with 5,000 platforms is given on the graphs. Both may be relevant in interpreting the data so both are given.

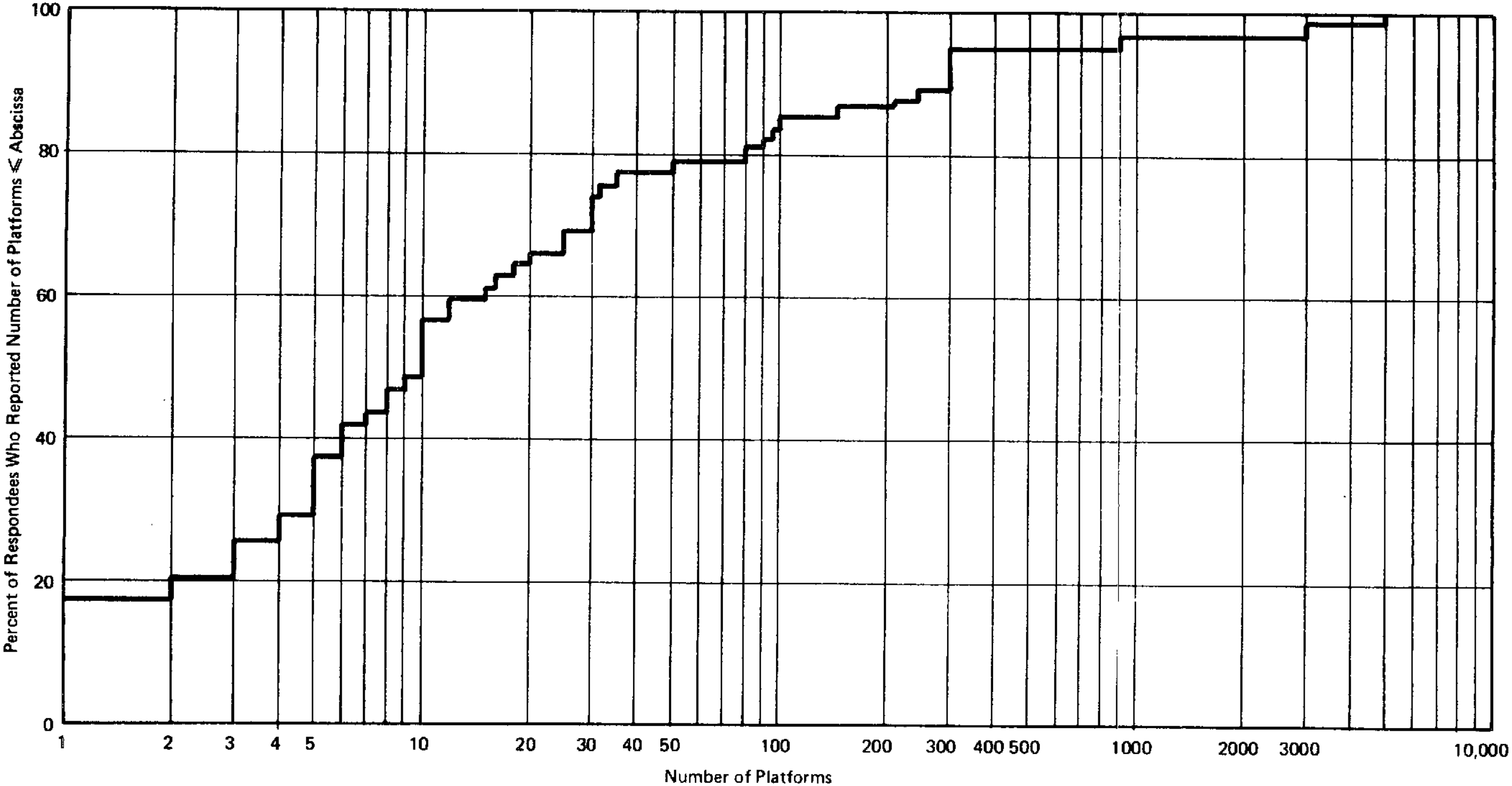

FIGURE 3.1. PERCENT OF RESPONDEES WHO REPORTED NUMBER OF PLATFORMS ≤ ABSCISSA

TABLE 3.58

DCP ACCURACY SPECIFICATION
(4 Decimal Digits Maximum)

Magnitude of Sensor Output Voltage	Number of Decimal Digits	Accuracy	Number* of Levels Required	Number of Bits (n)	Quantization Error
$0 \rightarrow .01$	1 2 3 4	1:10, 1MV 1:100, 10^{-4} V	10 100	4 7	$\pm 10^{-3}/2$ Volts $\pm 10^{-4}/2$ Volts
$0 \rightarrow .1$	1 2 3 4	1:10, 10^{-2} V 1:100, 1MV 1:1000, 10^{-4} V	10 100 1,000	4 7 10	$\pm 10^{-2}/2$ Volts $\pm 10^{-3}/2$ Volts $\pm 10^{-4}/2$ Volts
$0 \rightarrow 1$	1 2 3 4	1:10, .1V 1:100, .01V 1:1000, 1 MV 1:10^4, 10^{-4} V	10 100 1,000 10,000	4 7 10 14	$\pm 10^{-1}/2$ Volts $\pm 10^{-2}/2$ Volts $\pm 10^{-3}/2$ Volts $\pm 10^{-4}/2$ Volts
$0 \rightarrow < 10$	1 2 3 4	1:10, 1V 1:100, .1V 1:1000, .01V 1:10^4, 1 MV	10 100 1,000 10,000	4 7 10 14	$\pm 1/2$ Volts $\pm 10^{-1}/2$ Volts $\pm 10^{-2}/2$ Volts $\pm 10^{-3}/2$ Volts
$0 \rightarrow V$; $10 \leq V < 100$	1 2 3 4	1:V, 1V 1:V x 10, .1V 1:V x 10^2, .01V	V 10V 100V	$V \leq 2^n$ $10V \leq 2^n$ $100V \leq 2^n$	$\pm 1/2$ Volts $\pm 10^{-1}/2$ Volts $\pm 10^{-2}/2$ Volts
$0 \rightarrow V$; $100 \leq V < 1000$	1 2 3 4	1:V, 1V 1:10V, 1V	V 10V	$V \leq 2^n$ $10V \leq 2^n$	$\pm 1/2$ Volts $\pm 10^{-1}/2$ Volts

* Excluding Zero

required by the user (in number of decimal digits) is related to other platform parameters. The reason that the respondee was asked to specify decimal digits is evident from the table. The accuracy, number of quantization levels, and number of bits per measurement can all be related to the number of decimal digits if the analog voltage range of the sensor is known.

The results of the Decimal Precision question are given in Figure 3.3. As indicated, 32.25% of the users (67.97 of the platforms) indicated 2 digits. 38.71% of the users (13.62% of the platforms) indicated 3 digits. 24.19% of the users (15.99% of the platforms) indicated 4 digits.

Eight percent of the users did not answer the question yielding a Response Factor of 92%.

3.3.2.4 Analog Sensor Voltage Range

It cannot be anticipated that all sensor transducers connected to a DCP will have identical dynamic voltage ranges. It was thus necessary to determine what voltage ranges would be required by the users. Figure 3.4 shows the results of the user response to the question of Analog Voltage Range. As indicated, 38% of the users (75.4% of the platforms) anticipate a voltage range of 0 to 5 volts. Twenty-seven percent of the users (7.41% of the platforms) anticipate a voltage range of -10 to +10 volts. Finally, 16% of the users (3.21% of the platforms) indicated other voltage ranges. These ranges were:

- Unknown
- -50 to +50 mV
- -12 to +12 V.

The remaining 19% of the users (7.79% of the platforms) did not answer the question yielding a response factor of 81%.

3.3.2.5 Digital Sensor Bits per Measurement

Many sensors used in data collection systems have a digital output. What this means is that an A/D converter is incorporated as part of the sensor package. It is relevant then to determine the bits per measurement that can be anticipated from such "digital" sensors. As indicated in Figure 3.5, a wide range of values exist for digital sensors. The distribution is as shown in Table 3.59

TABLE 3.59

BITS PER MEASUREMENT DISTRIBUTION

Number of Bits	Percent of Users	Percent of Platforms
4	6.45	48.14
5	3.22	0.25
6	1.61	0.00
7	1.61	0.16
8	4.83	5.14
10	6.45	7.26
11	1.61	0.31
12	1.61	1.43
14	3.22	0.17
15	3.22	0.11
16	6.45	5.19
18	1.61	14.30
20	1.61	0.07
31	1.61	0.24
32	1.61	0.09
48	1.61	1.43

The remaining 51.5% of the users (15.56% of the platforms) did not answer the question yielding a response factor of 48.4%.

3.3.2.6 Synoptic Period

In any data collection system, sensor measurements are obtained as a function of time. The user may desire measurements on a

C2

continuous basis or he may desire them periodically. With this in mind, the users were asked to indicate their desired measurement interval (Synoptic Period). As indicated in Figure 3.6, a wide variety of synoptic periods are desired by the users. Table 3.60 shows the distribution of user interest among the various answers to the question.

Table 3.60

SYNOPTIC PERIOD DISTRIBUTION

Synoptic Period	Percent of Users	Percent of Platforms
cts	6.54	3.37
.5 hr	8.06	48.56
1.0 hr	29.03	5.16
2.0 hr	8.06	5.43
6.0 hr	14.51	3.81
12.0 hr	16.13	19.66
24.0 hr	22.58	12.71
Other	9.67	1.26

Of the 62 respondees, 6(9.67%) indicated synoptic periods other than those given in the questionnaire. These "other" values were:

- Unknown
- 1 minute
- 3 hours
- 1 week.

All the respondees answered this question. Thus the Response Factor was 100%.

3.3.2.7 Bit Rate for Continuous Transmission Platforms

Some of the users of a data collection system will require sensor data on a continuous basis. To properly size a data collection system in terms of communications capacity, it is necessary to know the data rate at which the DCP for such a user will transmit data to his monitoring station. Thus, in the questionnaire, the users were asked to state their anticipated data rate if it applied to their requirement. Figure 3.7 shows the results. Thirty-seven percent of the respondees (20.14% of the platforms) indicated a need for continuous transmission. The distribution of data rates among these users is given in Table 3.61.

TABLE 3.61

CONTINUOUS BIT RATE DISTRIBUTION

Bit Rate (BPS)	Percent of Users	Percent of Platforms
10	4.84	0.62
100	22.60	16.94
1,000	8.06	2.70
10,000	1.61	0.01

The remaining 63% of the respondees (79.85% of the platforms) did not answer the question yielding a Response Factor of 37%.

3.3.2.8 Commandable/Interrogateable Platforms

Many users of data collection systems may desire the capability to send commands to a DCP (e.g., to select sensors) or to interrogate (obtain data on demand) the DCP. For this reason, the users were asked if they desired such a capability. The results of this question are given in Figure 3.8. As shown in the figure, 32.25% of the users (59.12% of the platforms) stated that such a capability was unnecessary. 53.22% of the users (36.1% of the platforms) stated that such a capability was desireable. Finally, 4.84% of the users (3.35% of the platforms) stated that such a capability was mandatory. The remaining 10% of the users did not answer the question yielding a Response Factor of 90%.

3.3.2.9 Requirement for Position Location

A satellite data collection system can, in addition to the normal function of collecting data, provide a position location capability. That is, the system can automatically obtain position coordinates of the DCP. In the questionnaire, the users were asked if they desired such a capability. The results of this question are given in Figure 3.9. As shown in the figure, 3.22% of the users (.16% of the platforms) stated that a position location capability was unnecessary. 6.45% of the users (5.71% of the platforms) stated that a position location capability was desireable. Finally, 38.71% of the users (21.24% of the platforms) stated that a position location capability was mandatory. The remaining 52% of the users (72.85% of the platforms) did not answer the question yielding a Response Factor of 48%.

3.3.2.10 Environmental Temperature Range

The data collection platforms in a satellite data collection system will be subjected to a variety of environmental conditions. Of paramount importance are the temperature variations that the DCP will be subjected to. In the questionnaire, the users were to indicate the temperature range they anticipated for their DCP's. Figures 3.10 and 3.11 give the results of this question. The answers were numerous resulting in a need for two graphs. Figure 3.10 covers the temperature ranges which correspond to less than 100 platforms. Figure 3.11 covers the temperature ranges which correspond to more than 100 platforms. The distribution of temperature ranges is given in Table 3.62.

TABLE 3.62

ENVIRONMENTAL TEMPERATURE DISTRIBUTION

Temperature Range (^{o}F)	Percent of Users	Percent of Platforms
-100/+150	1.61	0.00
-75/+100	1.61	0.48
-50/+125	1.61	0.48
-50/+150	1.61	0.16
-20/+100	1.61	0.01
0/+120	1.61	1.43
+50/+100	3.22	0.25
-100/+ 50	1.61	4.80
-100/+100	9.67	52.28
-50/+ 50	4.84	2.47
-50/+100	37.1	6.58
-50/+120	1.61	14.37
0/+ 50	3.22	5.03
0/+100	25.80	11.40

The remaining 3.22% of the users (.22% of the platforms) did not answer the question resulting in a Response Factor of 97%.

3.3.2.11 Other Environmental Conditions

Depending on where the DCP is deployed, it can be subjected to a wide variety of environmental conditions. In the questionnaire, the users were asked to indicate the environmental conditions they anticipated. Figure 3.12 presents the results of the question. As shown in the figure 41.93% of the users (16.82% of the platforms) indicated that the DCP would be subject to submersion in salt water. 17.74% of the users (4.45% of the platforms) indicated that the DCP would be subject to submersion in fresh water. Finally, 67.74% of the users (75.43% of the platforms) indicated that the DCP would be subject to high humidity. Eleven percent of the users (9.69% of the platforms) stated that they anticipate other environmental conditions than those listed. These conditions consisted of:

- High Winds
- Icing
- Heavy Rains
- Heavy Snow
- Snow Loads
- Burial
- Vandal Damage
- Sustained Low Temperature
- Lightning
- High Altitude
- Dry/Windy
- High Seas
- Rapid Temperature Change
- Rapid Depth Change
- Interfacing Water Currents
- Vibration and Impact

The remaining 8% of the users (3.29% of the platforms) did not answer the question yielding a Response Factor of 92%.

3.3.2.12 Data Collection Platform Weight

In the questionnaire, the user was asked to specify the maximum allowable weight for his DCP. The results are given in Figure 3.13. Table 3.63 summarizes the distribution of weights among the users.

TABLE 3.63

DATA COLLECTION PLATFORM WEIGHT DISTRIBUTION

Weight	Percent of Users	Percent of Platforms
< 10g.	4.84	0.11
<100g.	8.06	0.65
< 1Kg.	11.29	5.76
<10Kg.	11.29	12.97
<20Kg.	11.29	4.09
No Restrictions	59.67	42.92
Other	8.06	27.38

As shown in Table 3.63, 8.06% of the users (27.38% of the platforms) indicated weights other than those given in the questionnaire. These "other" weights were:

- 5Kg
- 100Kg
- Portable
- Depends on Deployment.

Five percent of the users (6.1% of the platforms) did not answer the question yielding a Response Factor of 95%.

3.3.2.13 Platform Size

In the questionnaire, the user was asked to indicate what he considered a maximum allowable size for a Data Collection Platform. The results of this question are given in Figure 3.14. Table 3.64 summarizes the distribution of sizes among the users.

TABLE 3.64

DATA PLATFORM COLLECTION SIZE DISTRIBUTION

Size	Percent of Users	Percent of Platforms
Grape	3.22	0.08
Egg	9.67	0.56
Orange	6.45	0.33
Grapefruit	4.84	2.60
Watermelon	33.87	35.20
Other	53.22	56.32

The remaining 10% of the users (7.22% of the platforms) did not answer the question yielding a Response Factor of 90%.

3.3.2.14 Platform Orientation

In the deployment of data collection platforms, it is possible that the vertical plane of the DCP will not be parallel with the local vertical. This deviation from the local vertical may be permanent or a function of time (e.g., buoys). In the questionnaire, the user was asked to specify the orientation limits he anticipated with his DCP's. The results of the question are given in Figure 3.15. Table 3.65 summarizes the distribution of orientation limits among the users.

TABLE 3.65

DATA COLLECTION PLATFORM ORIENTATION DISTRIBUTION

Orientation	Percent of Users	Percent of Platforms
Fixed	29.03	3.67
Variable $\pm$ 5°	4.84	7.25
Variable $\pm$ 15°	19.35	5.08
Variable $\pm$ 30°	22.58	59.65
Random	32.26	17.89

The remaining 5% of the users (6.45% of the platforms) did not answer the question yielding a Response Factor of 95%.

3.3.2.15 Platform Protrusions

In many applications, protrusions (e.g., long antennas) can be detremental to the successful collection of data. For this reason, the users were asked to specify any limits on platform protrusions they deemed necessary. Figure 3.16 presents the results of this question. Table 3.66 summarizes the distribution of allowable protrusions among the users.

TABLE 3.66

DISTRIBUTION OF ALLOWABLE PLATFORM PROTRUSIONS

Protrusion Limit	Percent of Users	Percent of Platforms
Nonexistent	6.45	0.57
< 6 inches	11.30	1.04
< 2 feet	22.58	17.26
Unlimited	56.45	74.14

The remaining 8% of the users (6.98% of the platforms) did not answer the question yielding a Response Factor of 92%

3.3.2.16 Platform Construction

When deployed or being deployed, the data collection platform may be subjected to various types of handling, impact, etc. It is relevant then to determine what type of platform structural construction is required. To this end, the users were asked to specify the type of construction they considered adequate for their particular applications. Figure 3.17 shows the results of this inquiry. As shown in the figure, 64.51% of the users (82.18% of the platforms) indicated a need for rugged construction. 29.03% of the users (6.15% of the platforms) indicated a need for construction capable of withstanding everyday abuse. Finally, 11.29% of the users (11.64% of the platforms) indicated a need for frangible platforms. The remaining 3% of the users did not answer the question yielding a Response Factor of 97%.

3.3.2.17 Platform Type

Data Collection Platforms will come in many forms in a satellite data collection system and will be deployed in various fashions. For this reason it was considered relevant to determine how the DCP's would be deployed by the users. To this end, the users were asked to specify what type of deployment configuration they anticipated. The results of this question are given in Figure 3.18. Table 3.67 summarizes the distribution of platform types among the users.

TABLE 3.67

DATA COLLECTION PLATFORM TYPES DISTRIBUTION

Type	Percent of Users	Percent of Platforms
Buoy	41.93	42.38
Balloon	3.22	4.92
Animal	12.90	1.11
Fixed Site	62.90	46.64
Other	12.90	0.91

Of those users who answered the question, 12.9% indicated platform types other than those indicated in the questionnaire. These other types were:

- Platform secured to floating ice
- Platform on Oceanographic Vessel
- Platform on large Manned Spar Buoy
- Platform on Mobile Trailer
- Platform on Tower
- Platform with Nomadic Groups
- Platform on Aircraft.

Two percent of the users (4.02% of the platforms) did not answer the question yielding a Response Factor of 98%.

3.3.2.18 Expected Platform Life

To help in assessing the reliability requirements of data collection platforms, among other things, the users were asked to indicate the duration of their experiments which should coincide with the minimum expected life of their platforms. The results of this question are shown in Figure 3.19. The distribution of platform life expextancies among the users is shown in Table 3.68.

All of the users answered the question yielding a Response Factor of 100%.

TABLE 3.68

DATA COLLECTION PLATFORM EXPECTED LIFE DISTRIBUTION

Expected Life	Percent of Users	Percent of Platforms
1 Month	0.0	0.00
3 Months	4.84	2.71
6 Months	4.84	4.79
1 Year	19.35	9.18
2 Years	22.58	1.99
5 Years	12.90	1.70
Indefinite	40.32	79.58

3.3.2.19 User Cost Estimate

Of obvious importance in the implementation of data collection systems is the platform cost. In the questionnaire, the users were asked to indicate what they considered to be a reasonable cost for a data collection platform. This indicates how much a user is willing to spend (per platform) to participate in the system. The results of this question are given in Figure 3.20. Table 3.69 summarizes the distribution of platform costs among the users.

TABLE 3.69

DATA COLLECTION PLATFORM COST DISTRIBUTION

Cost (Dollars)	Percent of Users	Percent of Platforms
≤ 100	9.67	4.21
≤ 500	16.13	2.02
≤1,000	24.19	71.74
≤2,000	17.74	7.04
≤5,000	12.90	12.76
Other	6.45	0.76

Of those who answered the question 6.45% indicated costs other than those indicated in the questionnaire. These "other" costs were:

- Not Established
- $20,000.

The remaining 14% of the users (1.43% of the platforms) did not answer the question yielding a Response Factor of 86%.

3.3.2.20 Platform Data Response Summary

For future reference in studying and interpreting the data, this section, through Table 3.70, gives a tabulation of Response Factors for the various Platform Data questions.

TABLE 3.70

PLATFORM DATA RESPONSE FACTOR SUMMARY

Data	Response Factor
Number of Sensors per Platform	100%
Decimal Precision of Data	92%
Analog Sensor-Voltage Range	81%
Digital Sensor-Bits per Measurement	48.4%
Synoptic Period	100%
Bit Rate for Continuous Transmission	37%
Commandable/Interrogateable Platforms	90%
Position Location Requirement	48%
Environmental Temperature	96.8%
Other Environmental Conditions	92%
Platform Weight	95%
Platform Size	90%
Platform Orientation	95%
Platform Protrusions	92%
Platform Construction	97%
Platform Type	98%
Platform Life	100%
Platform Cost	86%

3.3.3 System Data

In this section, survey data directly related to data collection system requirements is presented. To directly relate to system requirements, the data is organized as follows:

- Geographic Disposition of Platforms
  - Geographic Area vs Number of Platforms
  - Distance between Platforms.
- Time Frame Requirements
  - Time of Implementation
  - Duration of Operation*
- Communications Capability/Capacity
  - Platform Population vs Time
    - Total Population
    - Population for each Geographic Area
  - Number of Sensors per Platform*
  - Decimal Precision of Data*
  - Digital Sensor-Bits per Measurement*
  - Synoptic Period*
  - Bit Rate for Continuous Transmission*
  - Commandable/Interrogatable Plaform*
- Position Location Capability
  - Position Location Required*
  - Position Location Accuracy
  - Position Location Rate
  - Position Location Data Delay
  - Platform Speed
  - Platform Acceleration between Measurements
- Data Dissemination
  - DCP Data Delay to Experimenter
  - Position Location Data Delay.

---

*The tabulations apply to both the system and platform requirements. Since they are given in the platform data (Section 3.2.2), they will not be duplicated in this section.

3.3.3.1 Geographic Area vs Number of Platforms

In the questionnaire, the users were asked to indicate how many platforms they planned to deploy in various geographic areas so that an estimate of the global platform population could be obtained. The results of this question are shown in Figure 3.21. Note that platform population as a function of time is given in Section 3.3.3.5. Table 3.71 summarizes the distribution of geographic areas among the users.

TABLE 3.71

DISTRIBUTION OF GEOGRAPHIC LOCATION OF PLATFORMS

Geographic Area	Percent of Users	Percent of Platforms
A	16.13	2.58
B	4.84	0.96
C	20.96	20.46
D	75.80	35.03
E	14.51	21.18
F	9.67	1.45
G	8.06	2.10
H	14.51	2.98
I	9.67	9.53
J	8.06	1.93
K	8.06	1.83
L	8.06	0.78

Five percent of the users did not answer the question yielding a Response Factor of 95%.

3.3.3.2 Distance Between Platforms

The density of Data Collection Platforms within a geographic area is important when sizing a satellite data collection system in terms of communications capacity. For this reason, the users were asked to indicate the minimum acceptable distance between their platforms. The results of the question are given in Figure 3.22. The distribution of distances among the users is given in Table 3.72.

TABLE 3.72

DISTRIBUTION OF PLATFORM SEPARATIONS

Minimum Separation	Percent of Users	Percent of Platforms
> 10KM	46.77	61.86
> 100KM	38.70	26.61
>1,000KM	1.61	0.11
Other	19.35	11.11

19.35% of the users indicated minimum separations other than those given in the questionnaire. These "other" values were as follows:

- To Be Determined
- Unrestricted
- 1 Kilometer
- < 10 Kilometers
- < 5 Kilometers
- 18 to 21 Kilometers (Depends on Project)
- > 5 Kilometers
- 400 to 600 Kilometers Optimum
- Random
- > 600 Kilometers
- No Minimum.

Two percent of the users (.28% of the platforms) did not answer the question yielding a Response Factor of 98%.

3.3.3.3 Time of Implementation

In the questionnaire, the users were asked to indicate when they planned to deploy their platforms. The results of this question are given in Figure 3.23. The sequel to this data, the duration of operation is given in Figure 3.19. 40.32% of the users (12.2% of the platforms) indicated a desire to deploy their platforms prior to 1974. 41.93% of the users (30.75% of the platforms) indicated a desire to deploy their platforms prior to 1977. Finally, 17.74% of the users (57.04% of the platforms) indicated a desire to deploy their platforms prior to 1980.

Two percent of the users (0% of the platforms) did not answer the question yielding a Response Factor of 98%.

3.3.3.4 Platform Population vs Time

To project system capacity requirements as a function of time it is necessary to know platform population as a function of time. Using the data from Figure 3.19 (Expected Platform Life) and Figure 3.23 (Time of Implementation), platform population curves were derived. Figure 3.24 shows total platform population (excluding the 5,000 platforms associated with a single users) as a function of time. Figures 3.25 through 3.36 give the platform population as a function of time for various geographic areas. Note that the numbers indicated are pessimistic since 16% of the respondees were assigned zero platforms because they did not specify a number.

3.3.3.5 Position Location Accuracy

The users desiring a position location capability were asked to indicate what accuracy they required. The results of this question are shown in Figure 3.37. Table 3.73 summarizes the distribution of accuracies among the users.

TABLE 3.73

DISTRIBUTION OF POSITION LOCATION ACCURACY

Minimum Accuracy	Percent of Users	Percent of Platforms
1 KM	22.58	4.77
2 KM	12.90	10.46
5 KM	9.67	10.83
10 KM	3.22	0.65
50 KM	0.00	0.00
Other	0.00	0.00

Fifty-five percent of the users did not answer the question yielding a response factor of 45%.

3.3.3.6 Position Location Rate

An important factor related to the Position Location Capability of Satellite Data Collection Systems is the rate at which estimates of position are to be made. There are practical limitations on this rate and it is of interest to determine if user requirements are in line with these limitations. In the survey questionnaire, the users were asked to indicate the position location rate they desired. The results of this question are shown in Figure 3.38. Table 3.74 summarizes the distribution of rates among the users.

TABLE 3.74

DISTRIBUTION OF POSITION LOCATION RATES

Rate	Percent of Users	Percent of Platforms
15 Minutes	0.00	0.00
30 Minutes	1.61	0.09
1 Hour	12.90	2.33
2 Hours	4.84	5.56
6 Hours	6.45	2.54
12 Hours	6.45	7.18
24 Hours	9.67	5.97
Other	4.84	3.24

As indicated in Table 3.74, 4.84% of the users indicated a position location rate other than those given in the questionnaire. The "other" rates were as follows:

- One Week
- 3 Hours
- On Demand and 6 Hours.

Fifty-six percent of the users (73.32% of the platforms) did not answer the question yielding a Response Factor of 44%.

3.3.3.7 Position Location Data Delay

In some research using satellite data collection systems, the time at which the experimenter gets the position location data may be critical. The users were queried on this subject. The results of the question are given in Figure 3.39. Table 3.75 summarizes the distribution of delays among the users.

TABLE 3.75

DISTRIBUTION OF POSITION LOCATION DATA DELAYS

Data Delay	Percent of Users	Percent of Platforms
Continuous	0.00	0.00
1/2 Hour	4.84	2.84
1 Hour	4.84	4.92
2 Hours	1.61	2.39
12 Hours	6.45	3.32
24 Hours	12.90	7.78
Other	12.90	5.09

3.3.3.8 Platform Speed

When designing a data collection and position location system one must account for the speed of the platform to be located. Thus it was considered relevant to query the users on this subject. In the questionnaire, the users were asked to indicate the platform speeds they anticipated for their requirements. Figure 3.40 shows the results of this question. Table 3.76 summarizes the distribution of platform speeds among the users.

Sixty-five percent of the users (77.03% of the platforms) did not answer the question yielding a Response Factor of 35%.

TABLE 3.76

DISTRIBUTION OF DATA COLLECTION PLATFORM SPEEDS

Platform Speed	Percent of Users	Percent of Platforms
< 1 KM/Hr	11.29	4.12
< 10 KM/Hr	19.35	12.04
<100 KM/Hr	6.45	6.80

3.3.3.9 Platform Acceleration Between Measurements

If the velocity of a platform between position location measurements is not constant, errors are introduced into the calculation of position. To account for such errors it is useful to know what the platform acceleration is between measurements. To obtain an estimate of the possible accelerations, the users were asked to identify, if possible, the accelerations they anticipated for their particular application. Figure 3.41 gives the results of this question. As shown in the figure, 8.06% of the users (6.91% of the platforms) anticipate constant velocity between measurements. 30.64% of the users (16.04% of the platforms) anticipate Random Velocity between measurements.

Sixty-one percent of the users did not answer the question yielding a Response Factor of 39%.

3.3.3.10 Data Delay

When designing a total data collection system, a significant parameter is the tolerable delay between the time that a measurement is made at the DCP and the time that the data reaches the user. In the questionnaire, the users were asked to indicate the delays that they considered tolerable. Figure 3.42 shows the results of this question. Table 3.77 summarizes the distribution of delays among the users.

TABLE 3.77

DISTRIBUTION OF DCP DATA DELAY

Delay	Percent of Users	Percent of Platforms
1/2 Hour	8.06	53.43
1 Hour	11.29	20.60
12 Hours	30.64	15.06
1 Week	32.25	7.69
1 Month	12.90	2.46
Other	9.67	0.72

As shown in Table 3.77, 9.67% of the users indicated a requirement for delays other than those given. These "other" values were:

- To Be Determined
- Variable, Depending on Sensor
- 2-3 Hours
- 1 Day
- As Soon as Possible.

3.3.3.11 <u>System Data Response Summary</u>

For future reference in studying and interpreting the data, this section, through Table 3.78, gives a tabulation of Response Factors for the System Data questions not included in the Platform Data.

TABLE 3.78

RESPONSE FACTORS FOR SYSTEM DATA QUESTIONS

Data	Response Factor
Geographic Area vs Number of Platforms	95%
Distance Between Platforms	98%
Time of Implementation	98%
Position Location Accuracy	45%
Position Location Rate	44%
Position Location Data Delay	44%
Platform Speed	35%
Platform Acceleration	39%
DCP Data Delay	100%

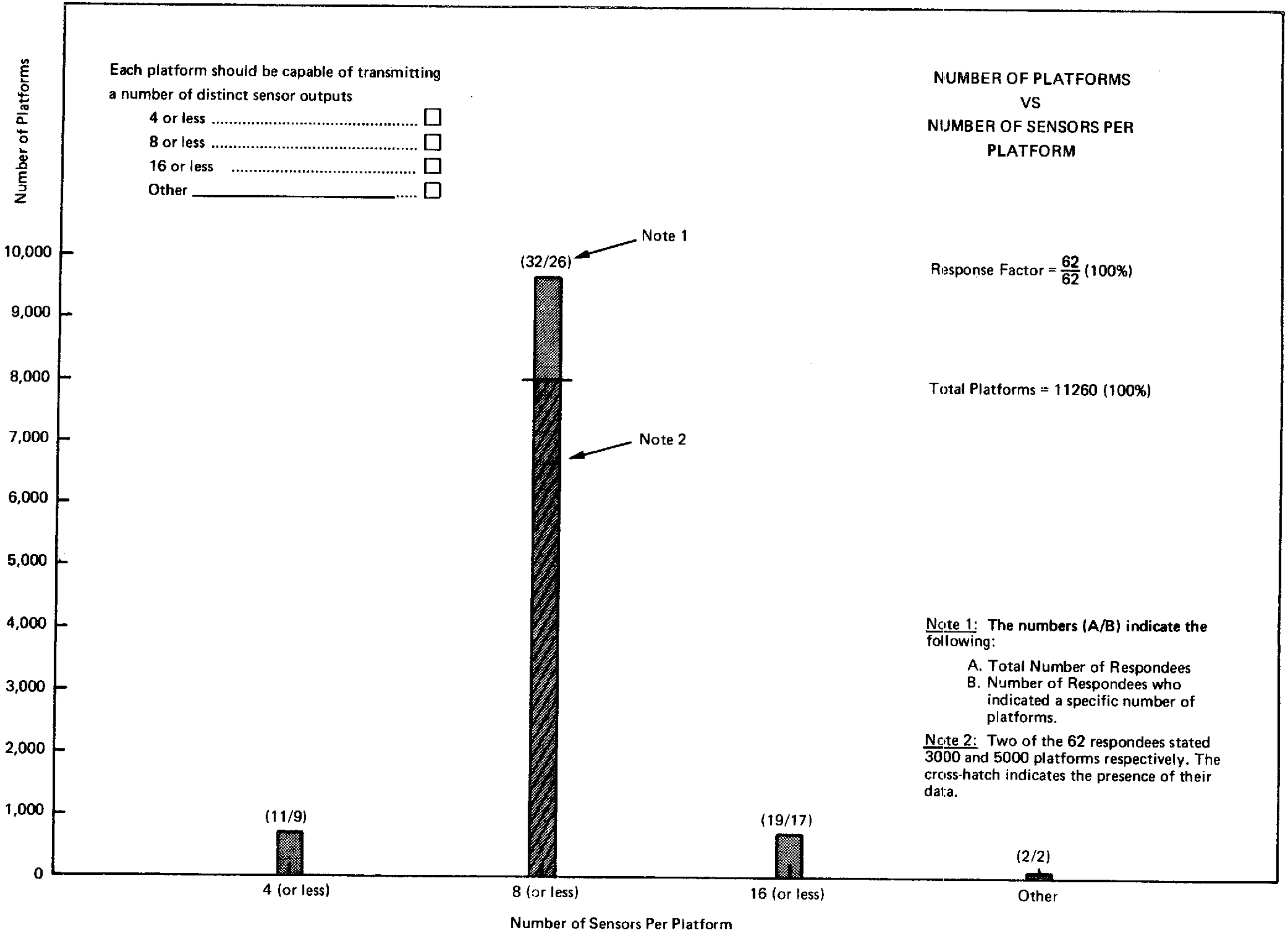

FIGURE 3.2. NUMBER OF PLATFORMS VS NUMBER OF SENSORS PER PLATFORM

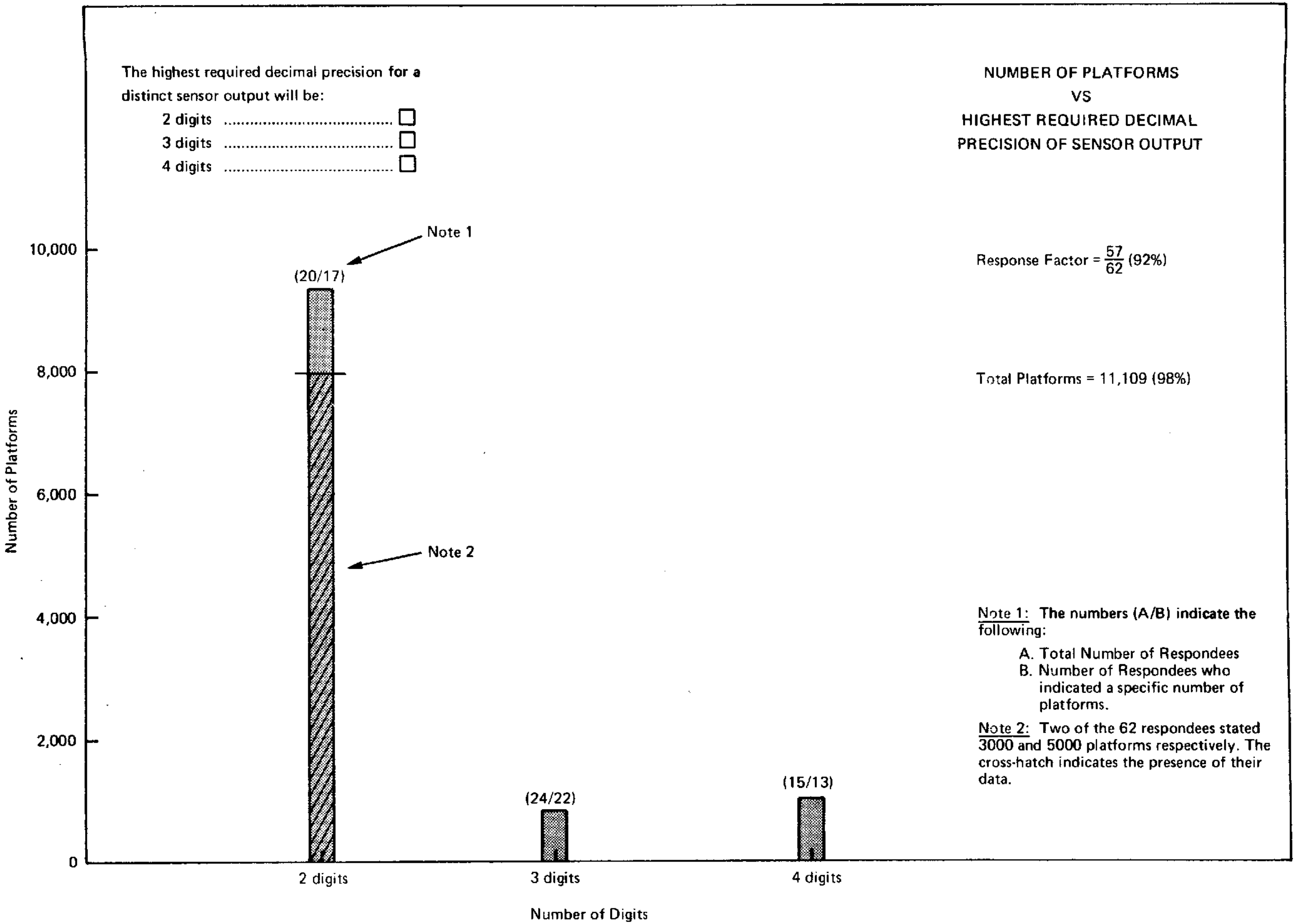

FIGURE 3.3. NUMBER OF PLATFORMS VS HIGHEST REQUIRED DECIMAL PRECISION OF SENSOR OUTPUT

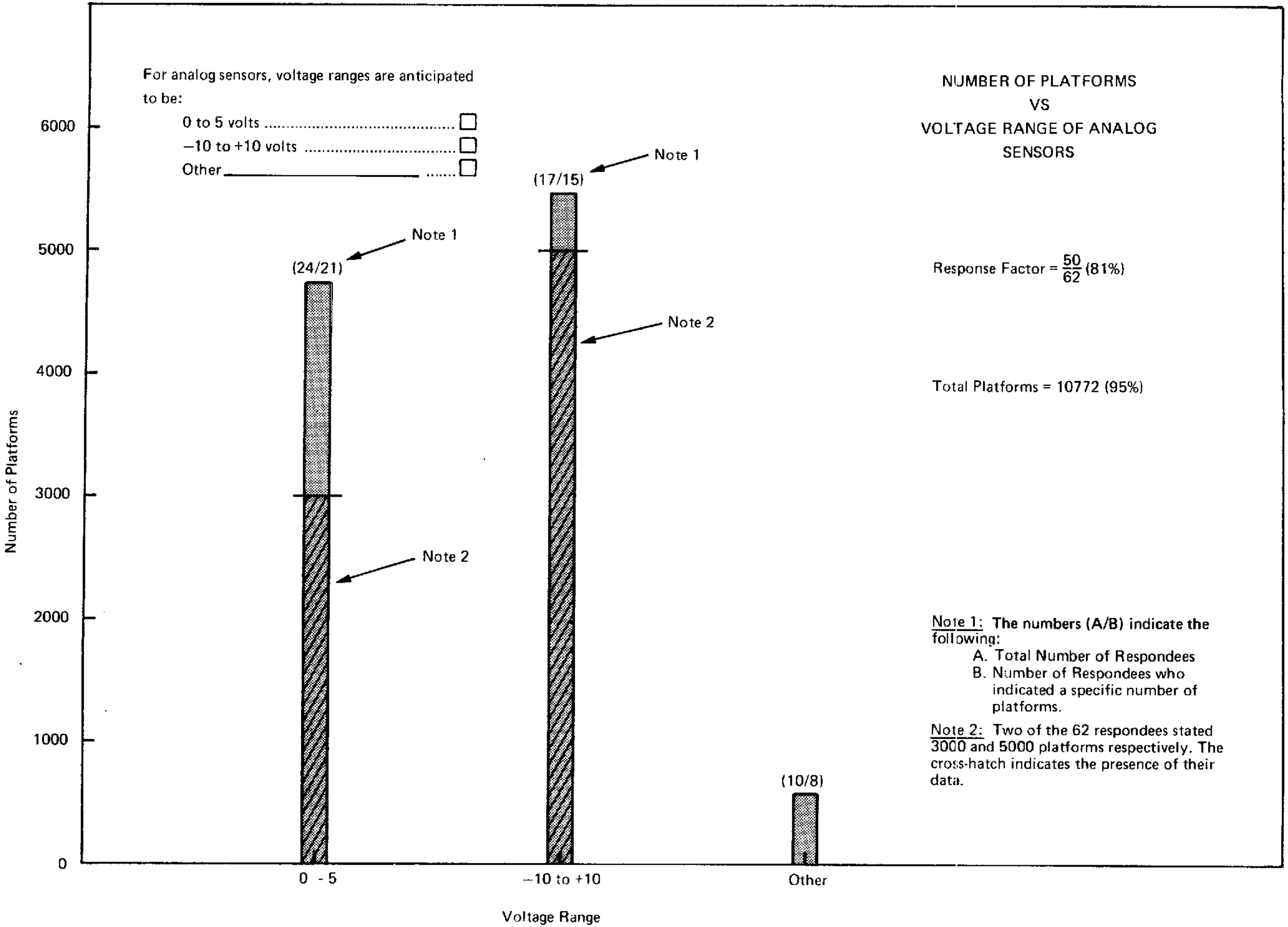

FIGURE 3.4. NUMBER OF PLATFORMS VS VOLTAGE RANGE OF ANALOG SENSORS

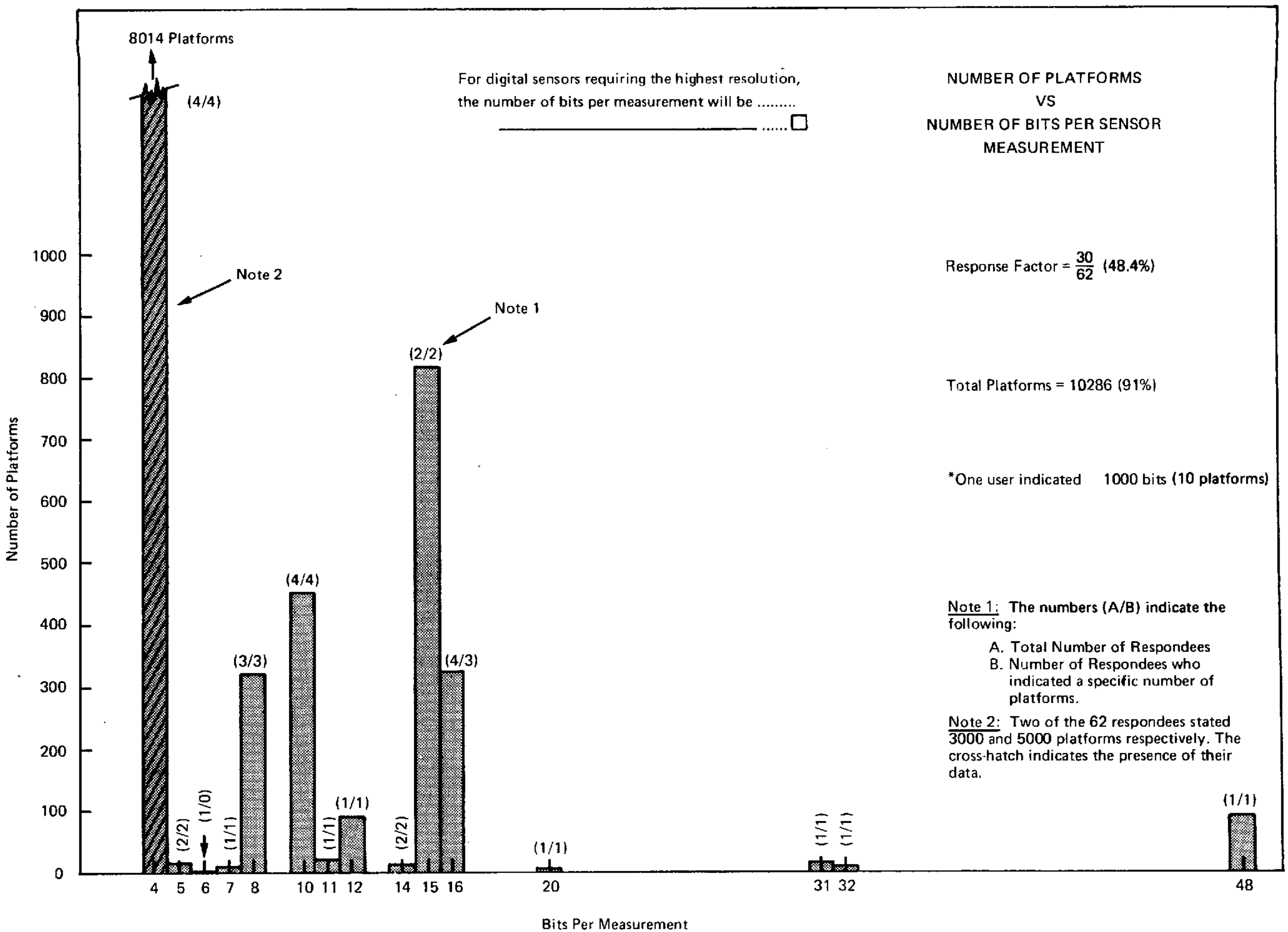

FIGURE 3.5. NUMBER OF PLATFORMS VS NUMBER OF BITS PER SENSOR MEASUREMENT

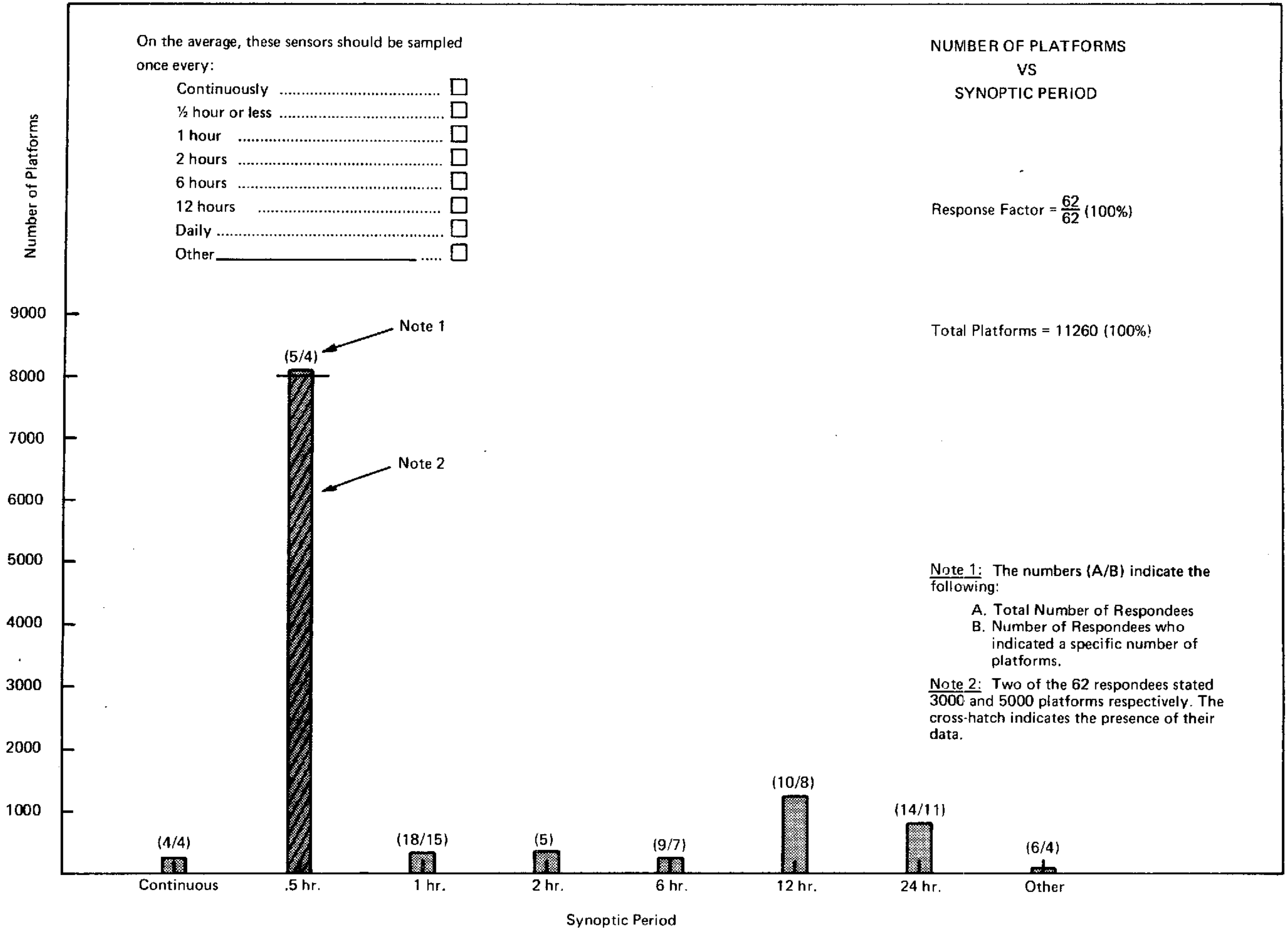

FIGURE 3.6. NUMBER OF PLATFORMS VS SYNOPTIC PERIOD

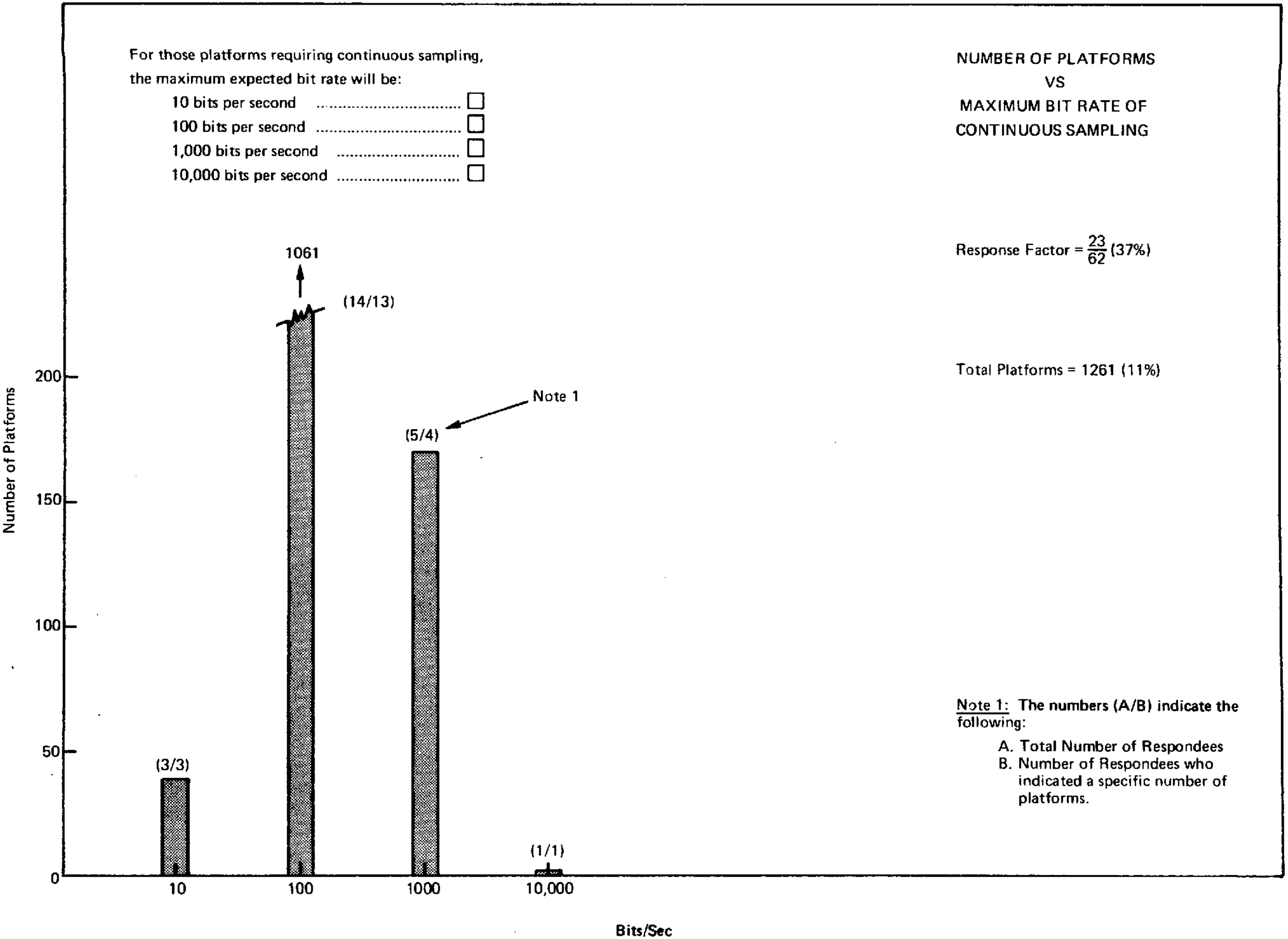

FIGURE 3.7. NUMBER OF PLATFORMS VS MAXIMUM BIT RATE OF CONTINUOUS SAMPLING

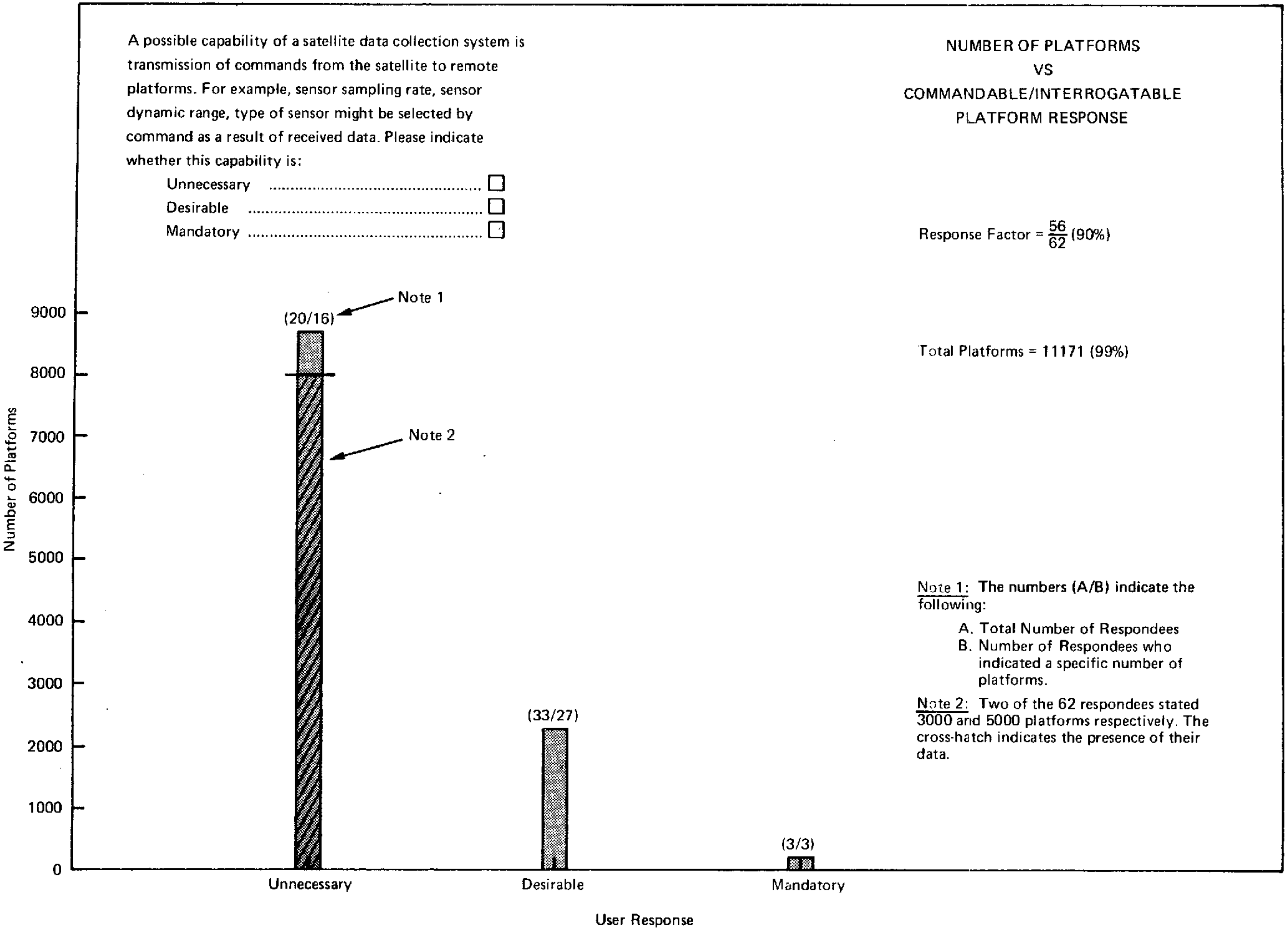

FIGURE 3.8. NUMBER OF PLATFORMS VS COMMANDABLE/INTERROGATABLE PLATFORM RESPONSE

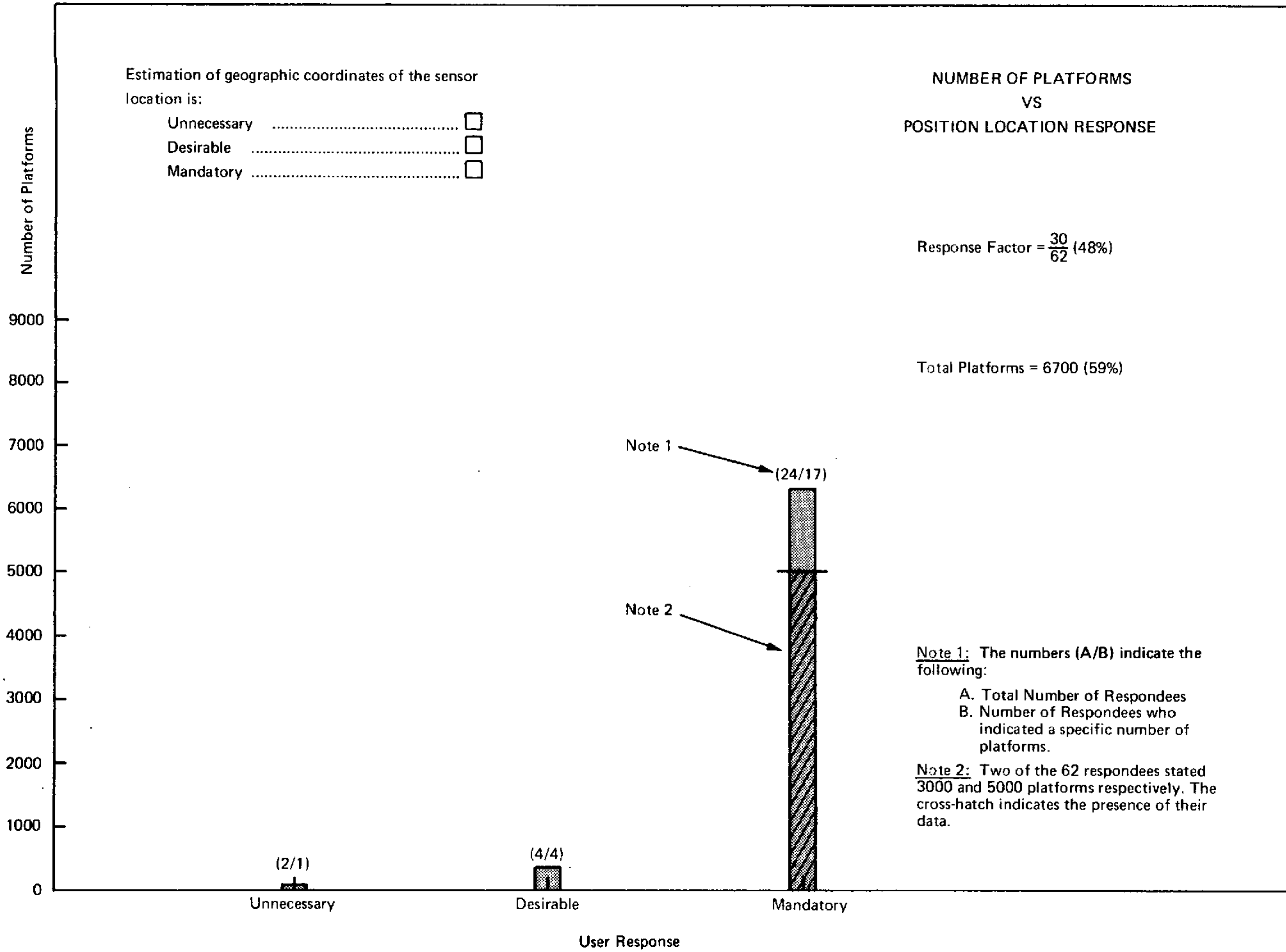

FIGURE 3.9. NUMBER OF PLATFORMS VS POSITION LOCATION RESPONSE

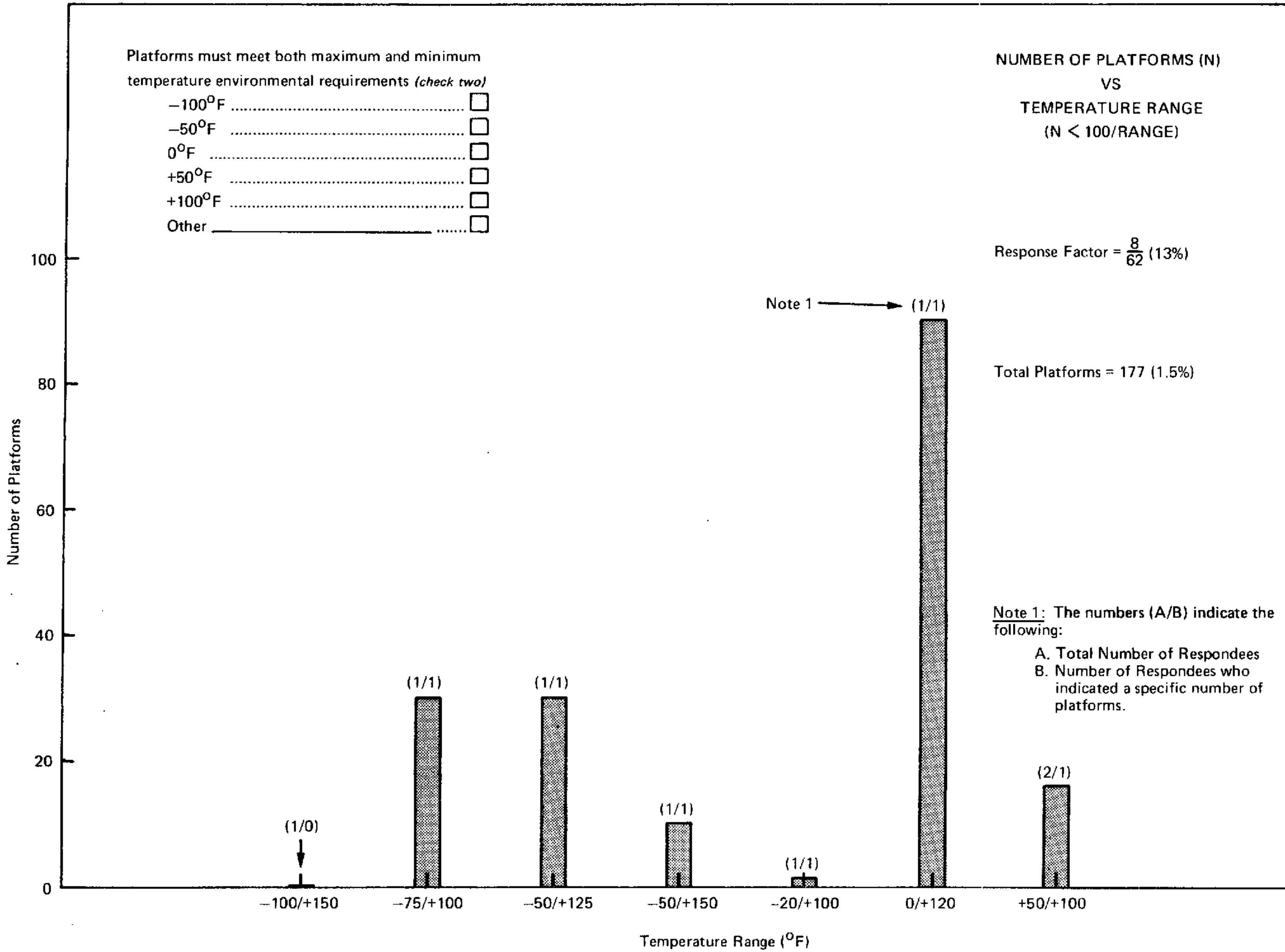

FIGURE 3.10. NUMBER OF PLATFORMS (N) VS TEMPERATURE RANGE (N < 100/RANGE)

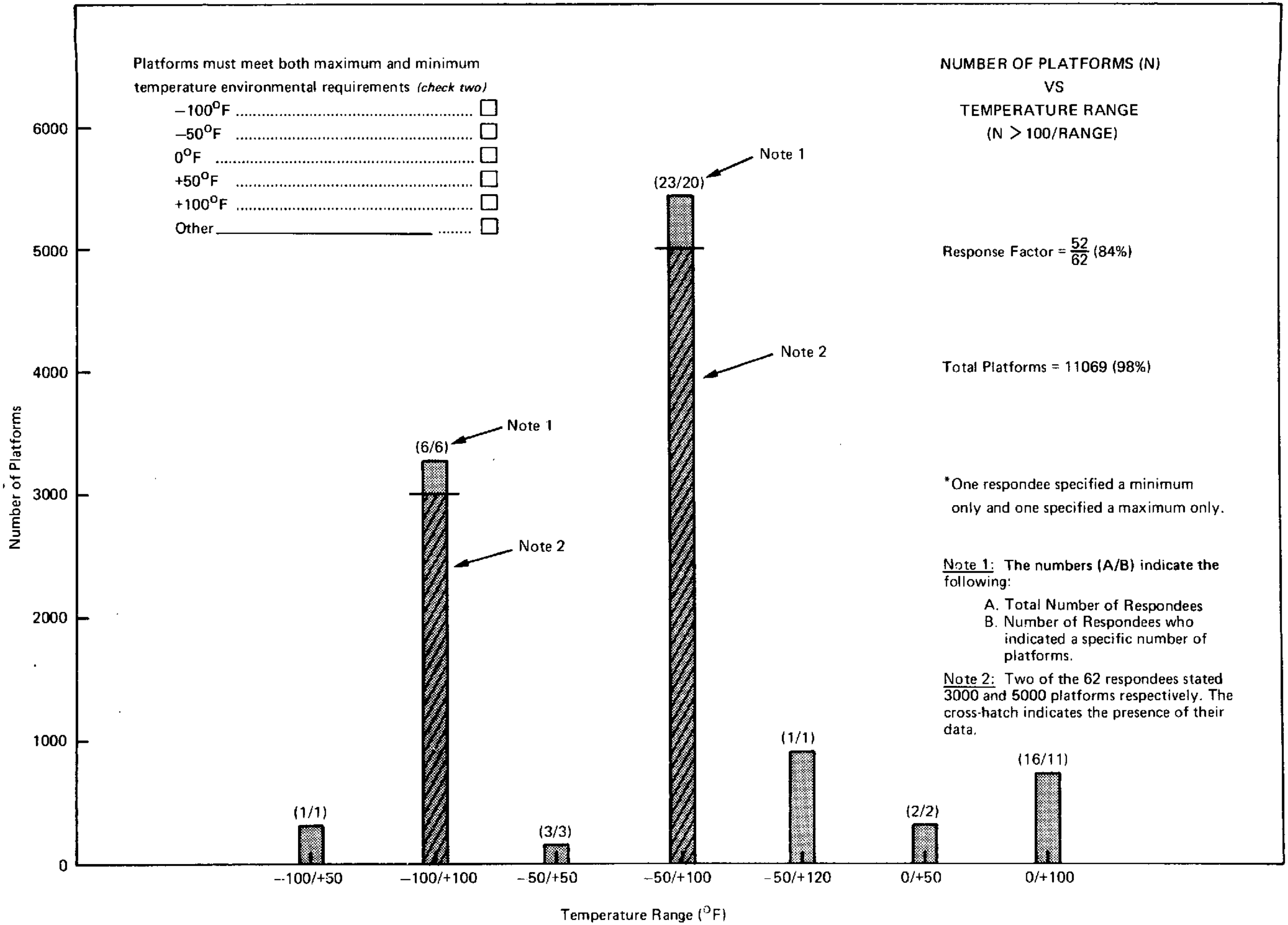

FIGURE 3.11. NUMBER OF PLATFORMS (N) VS TEMPERATURE RANGE (N >100/RANGE)

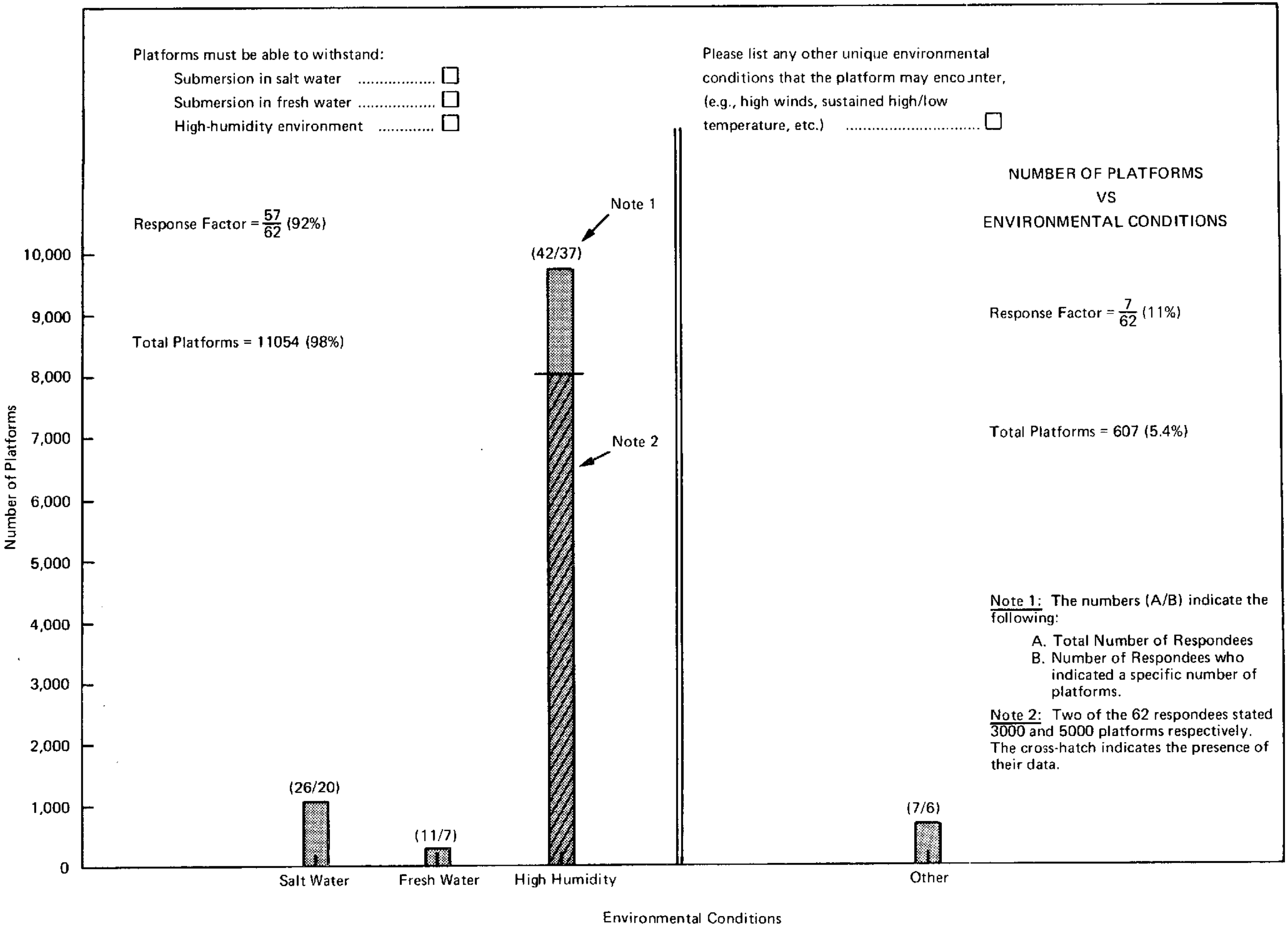

FIGURE 3.12. NUMBER OF PLATFORMS VS ENVIRONMENTAL CONDITIONS

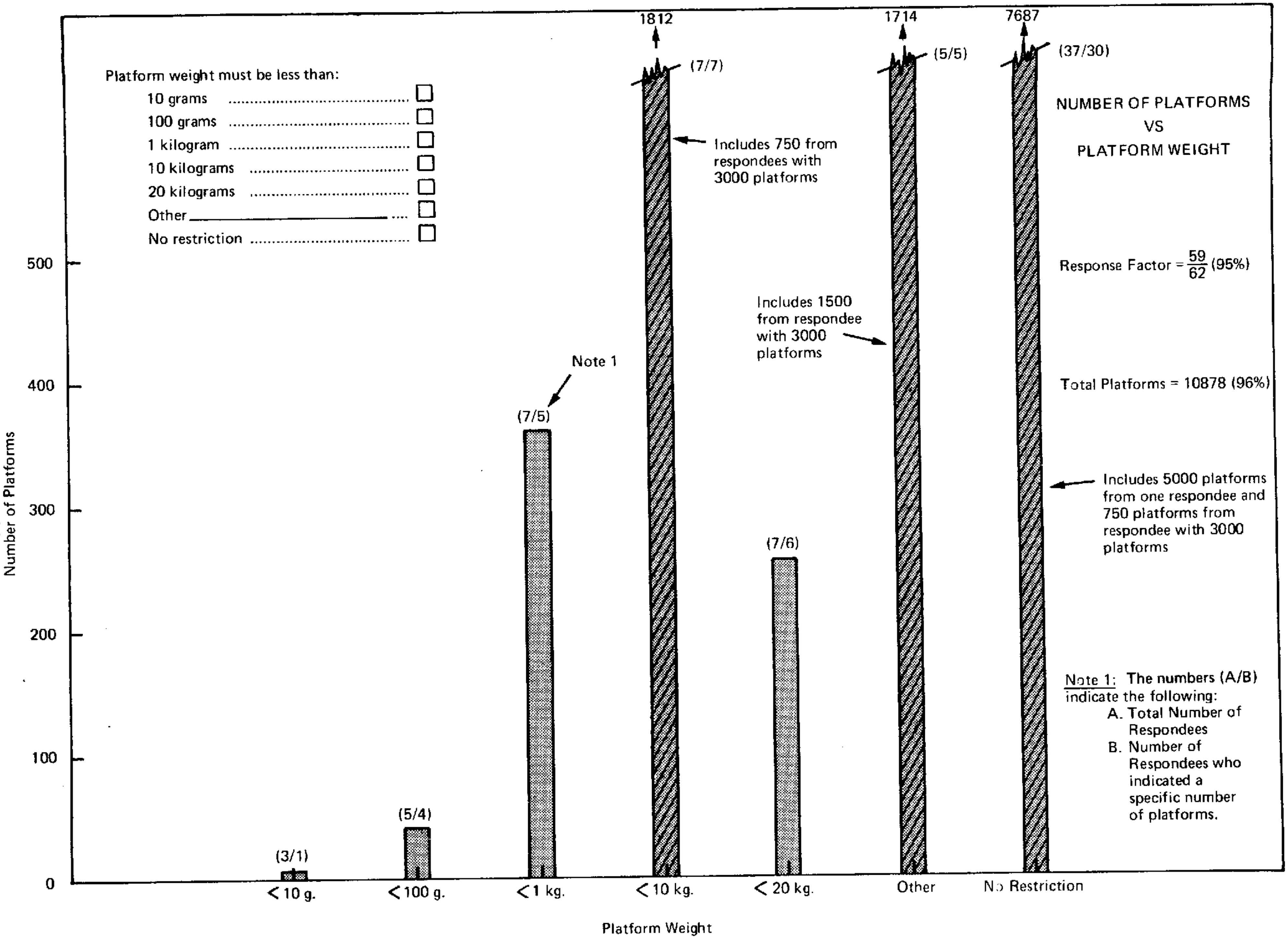

FIGURE 3.13. NUMBER OF PLATFORMS VS PLATFORM WEIGHT

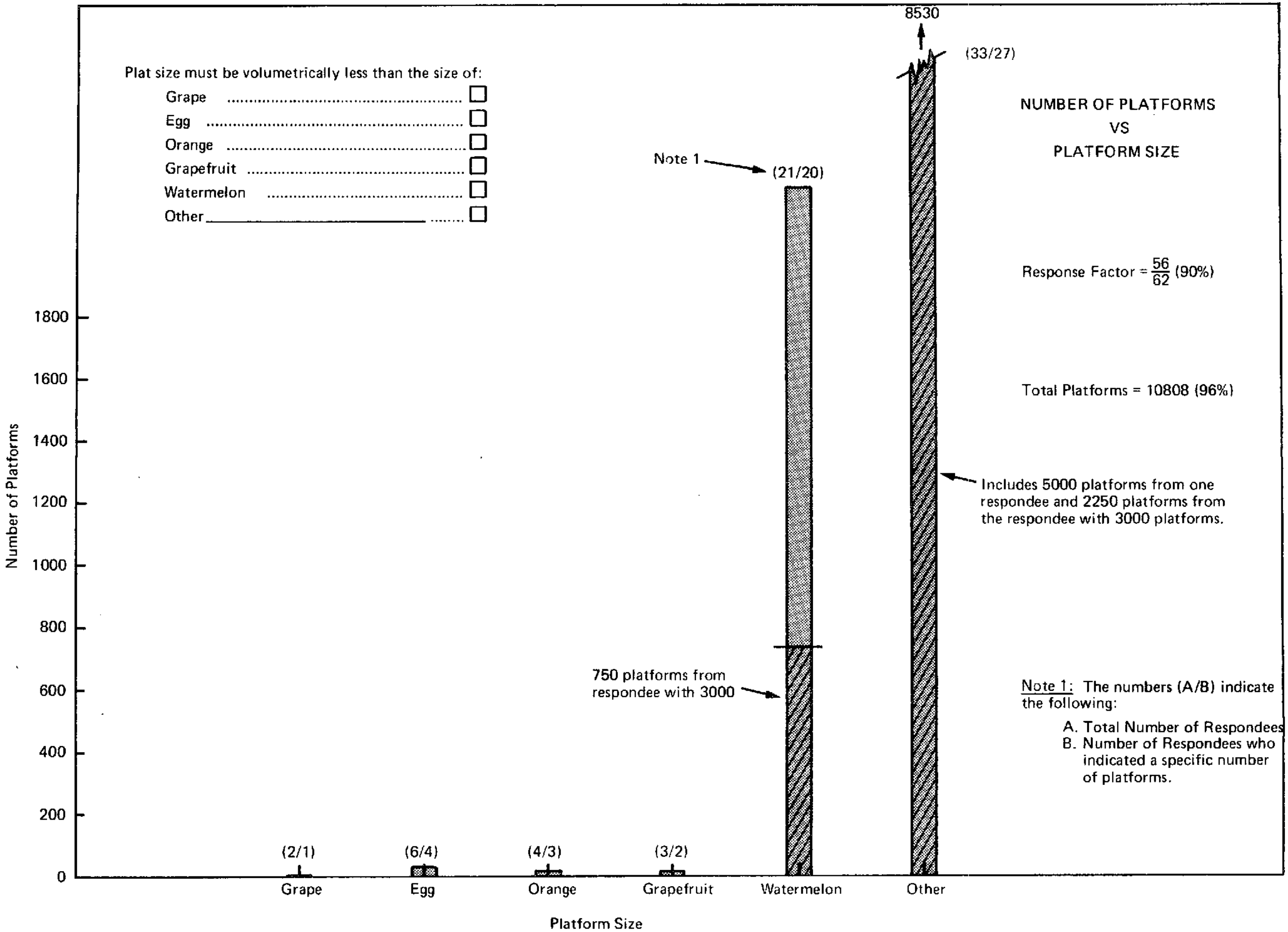

FIGURE 3.14. NUMBER OF PLATFORMS VS PLATFORM SIZE

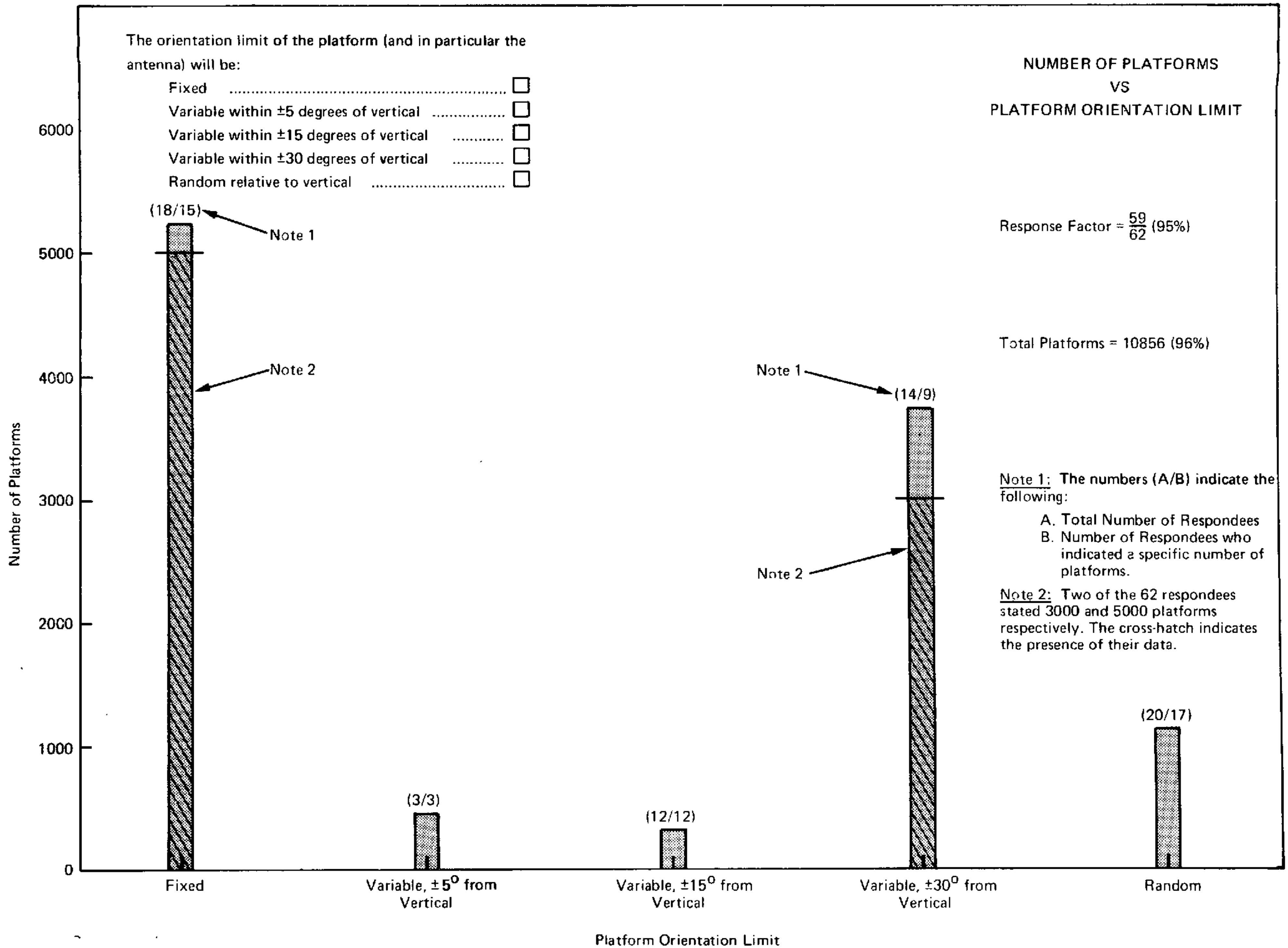

FIGURE 3.15. NUMBER OF PLATFORMS VS PLATFORM ORIENTATION LIMIT

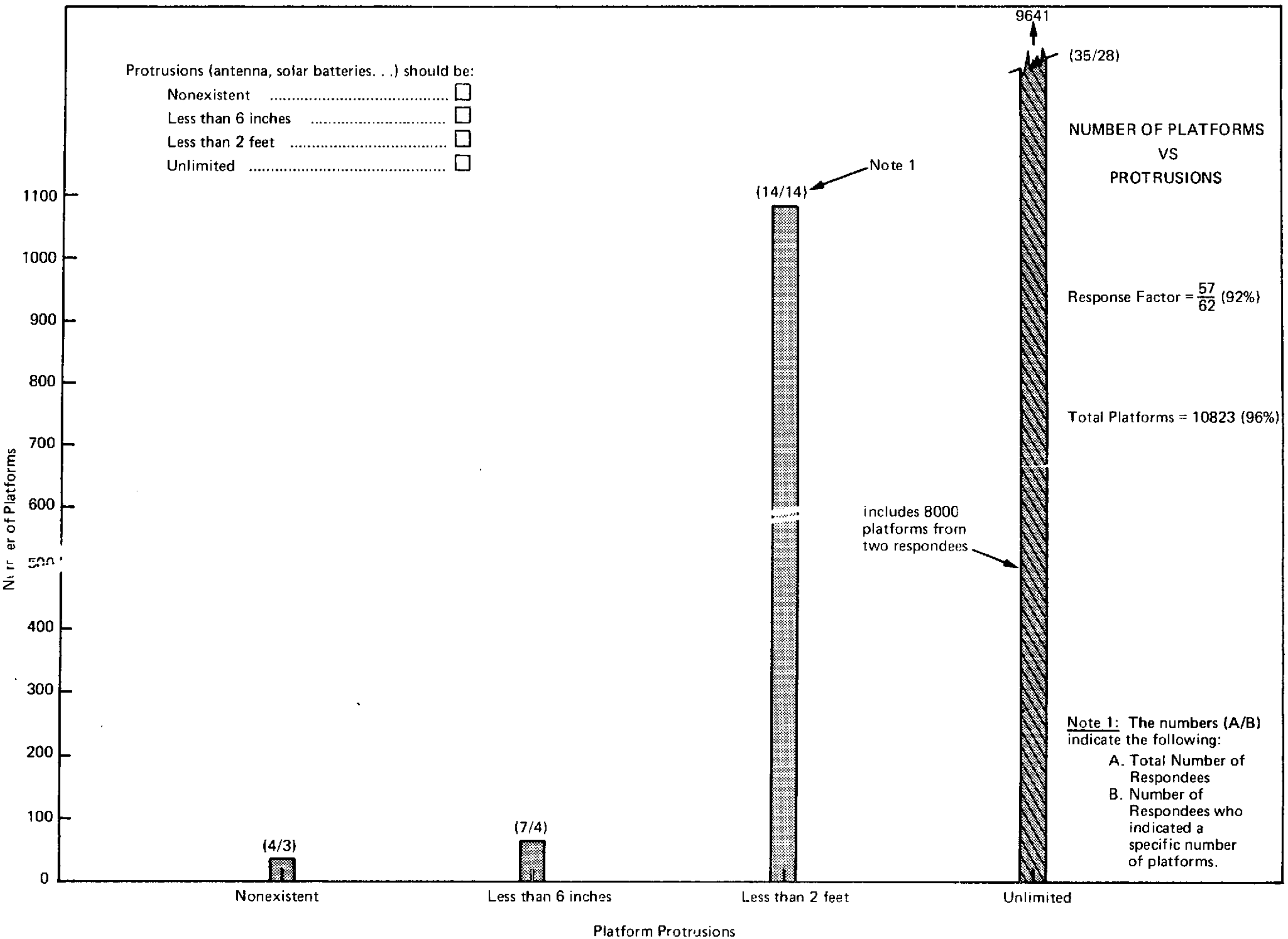

FIGURE 3.16. NUMBER OF PLATFORMS VS PROTRUSIONS

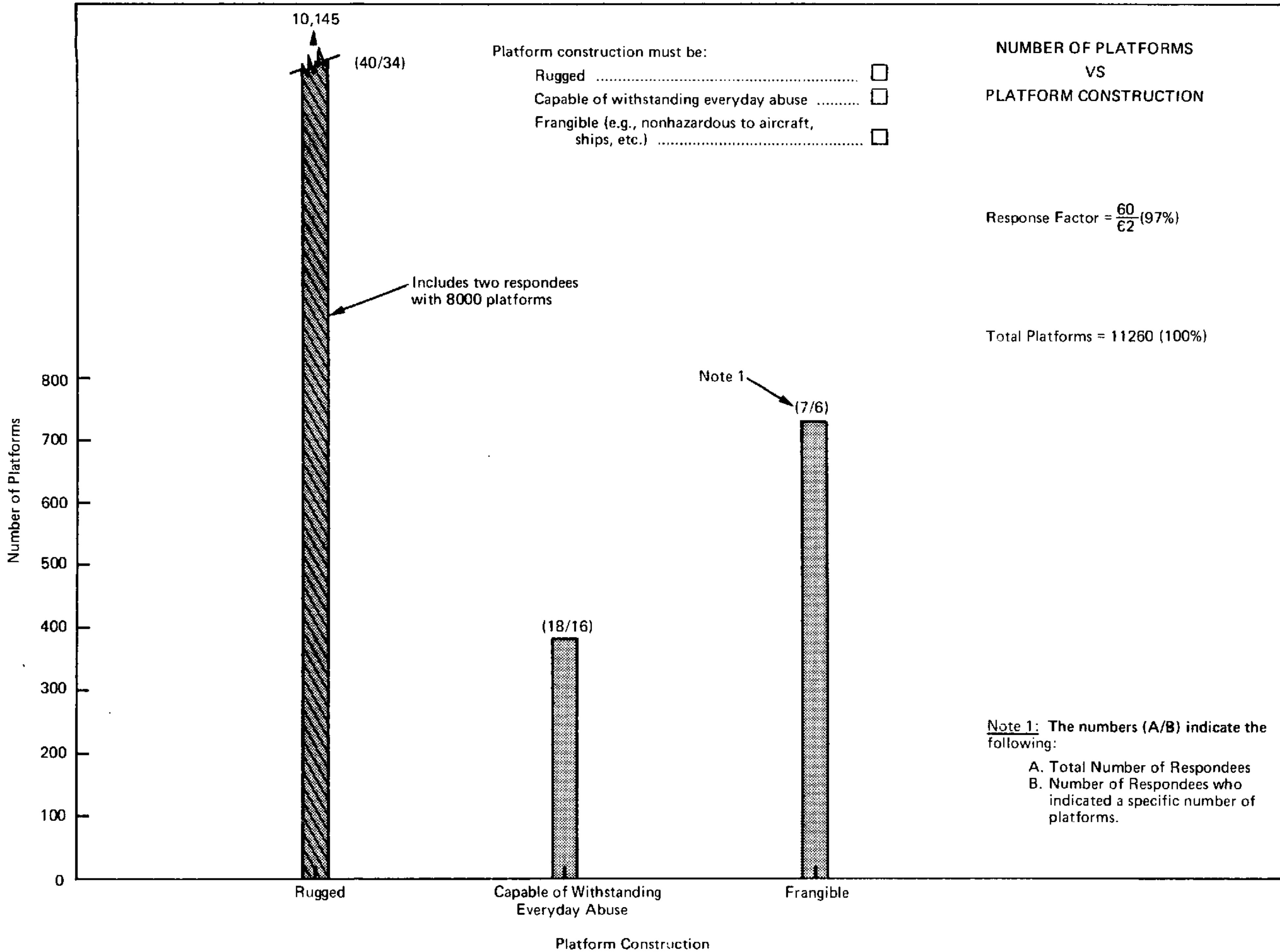

FIGURE 3.17. NUMBER OF PLATFORMS VS PLATFORM CONSTRUCTION

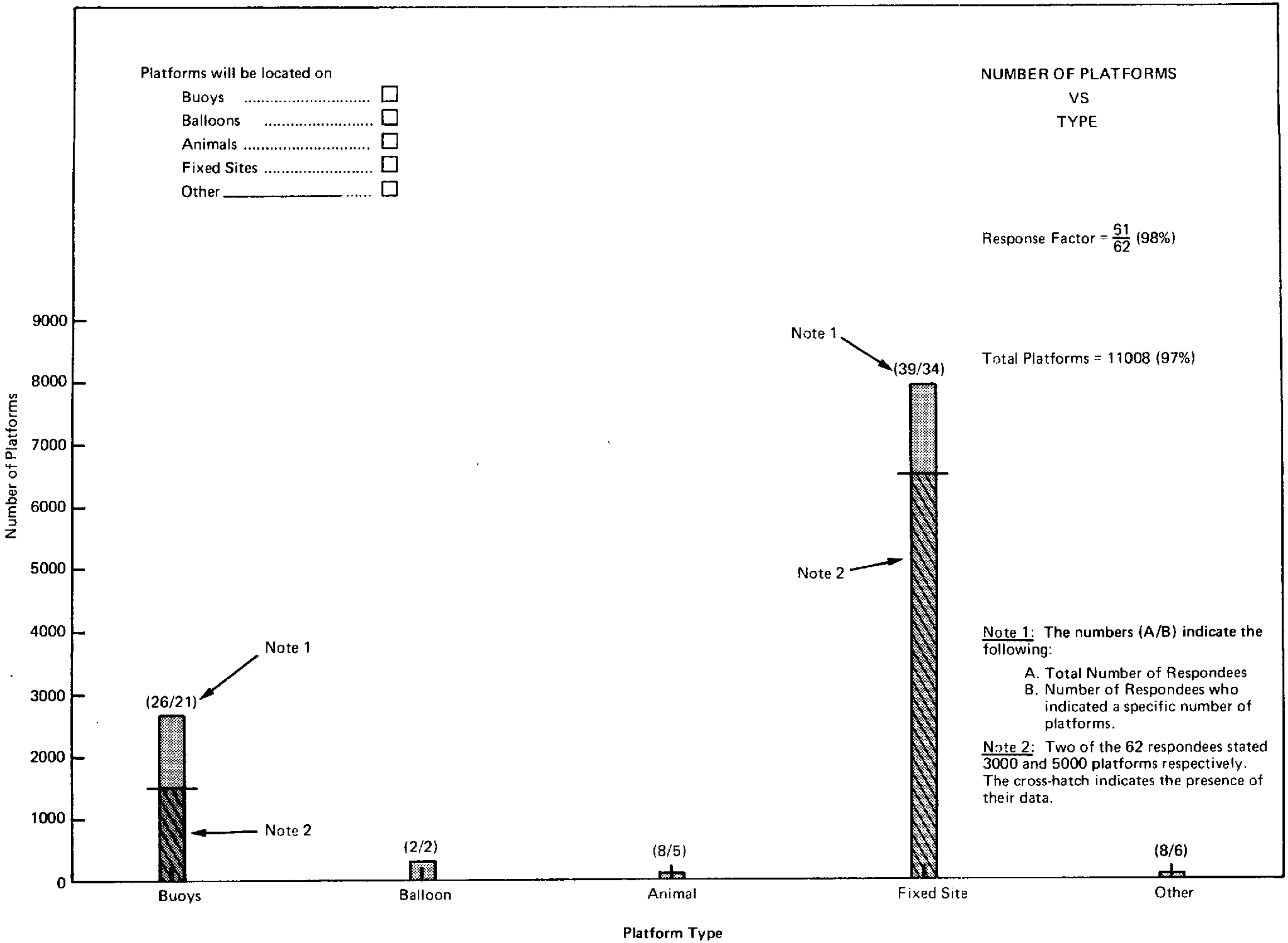

FIGURE 3.18. NUMBER OF PLATFORMS VS TYPE

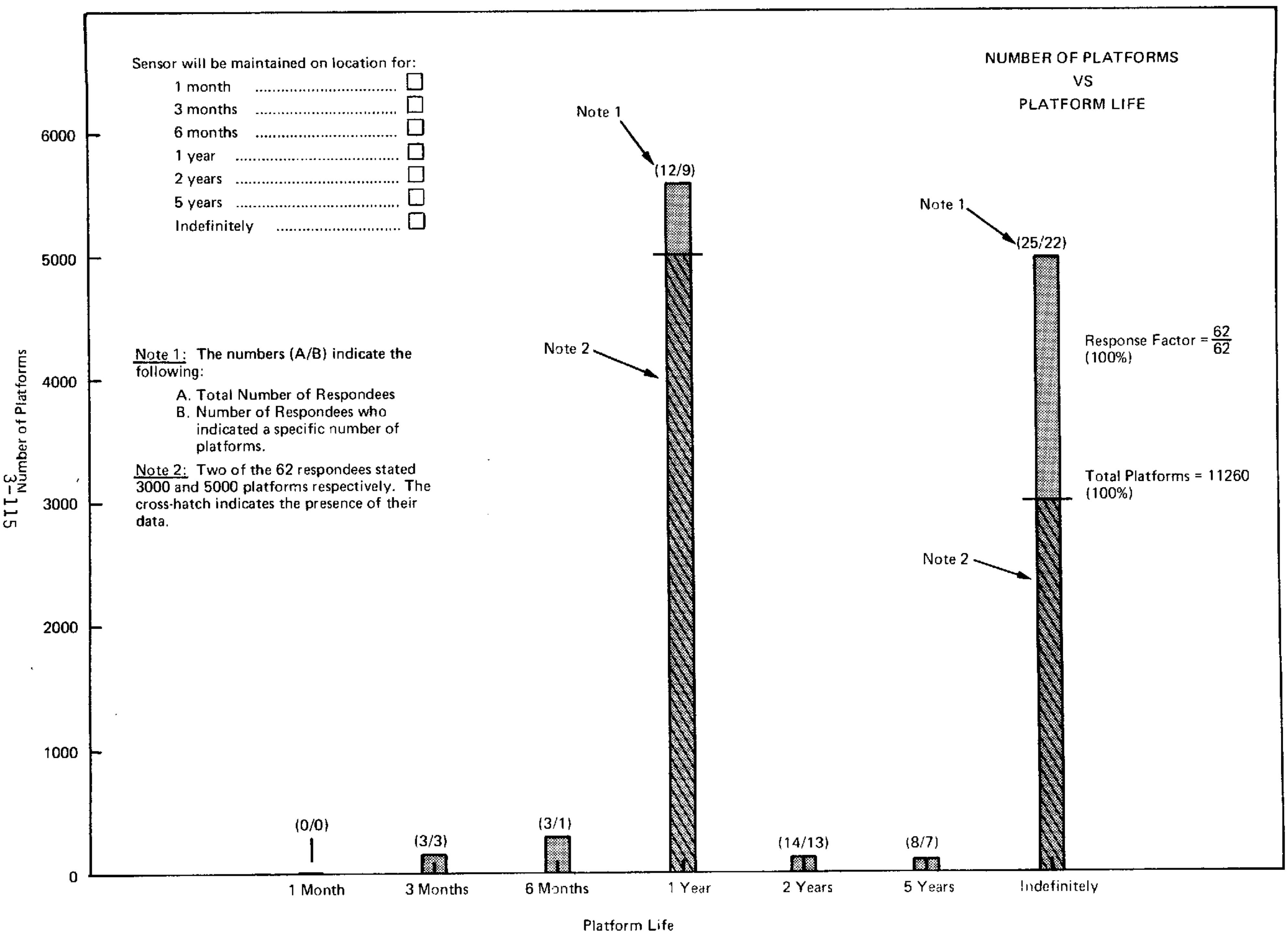

FIGURE 3.19. NUMBER OF PLATFORMS VS PLATFORM LIFE

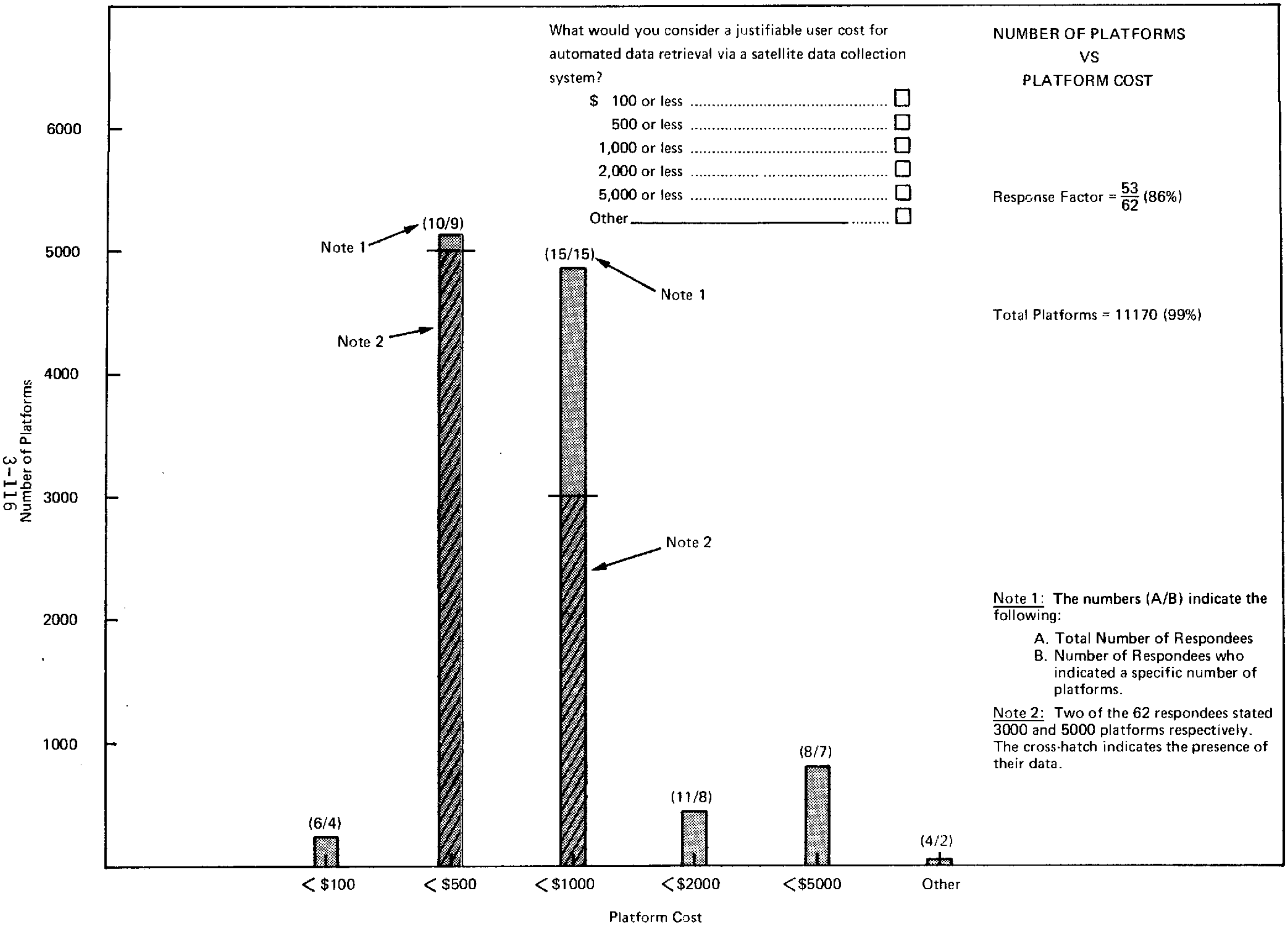

FIGURE 3.20. NUMBER OF PLATFORMS VS PLATFORM COST

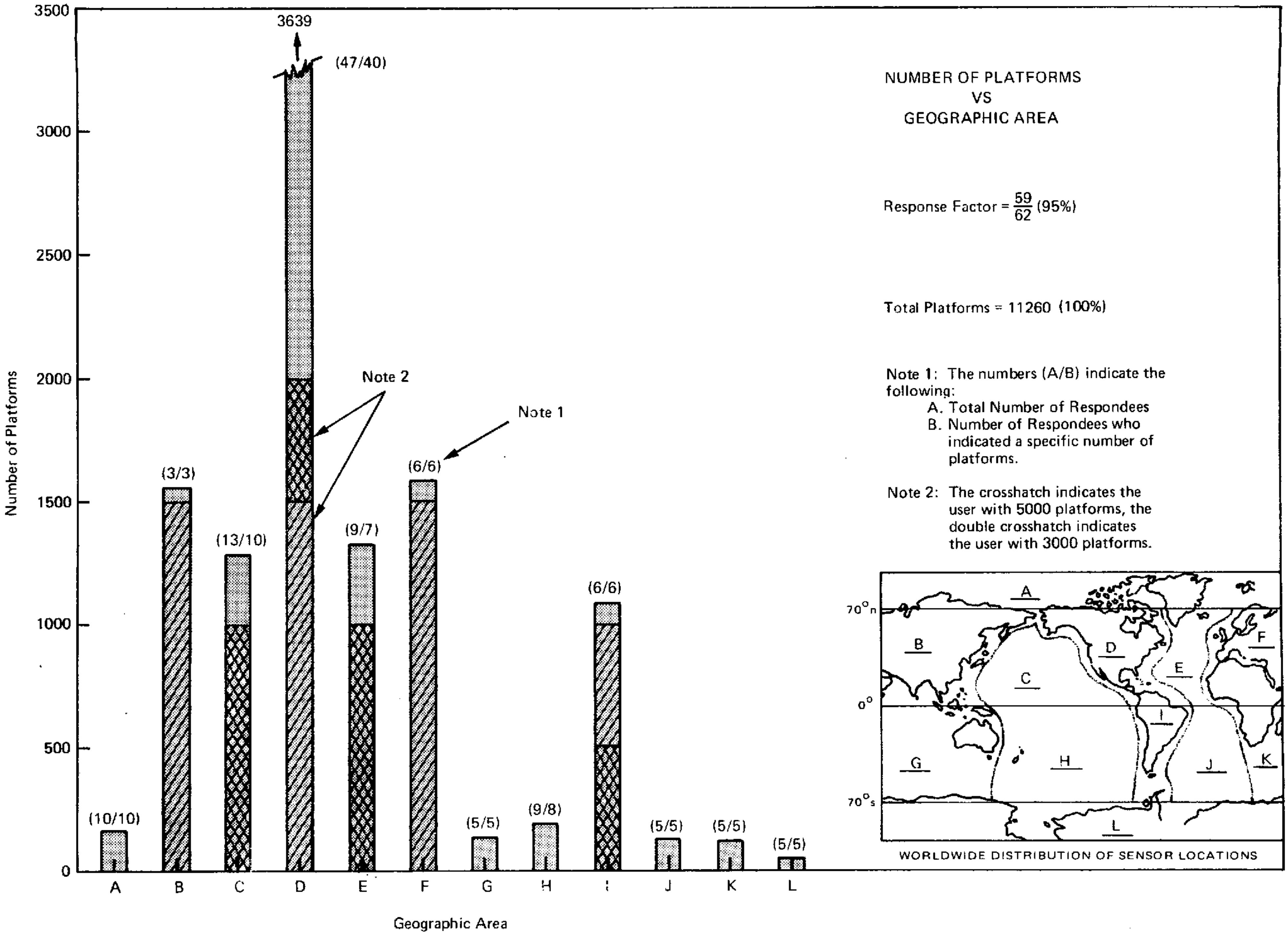

FIGURE 3.21. NUMBER OF PLATFORMS VS GEOGRAPHIC AREA

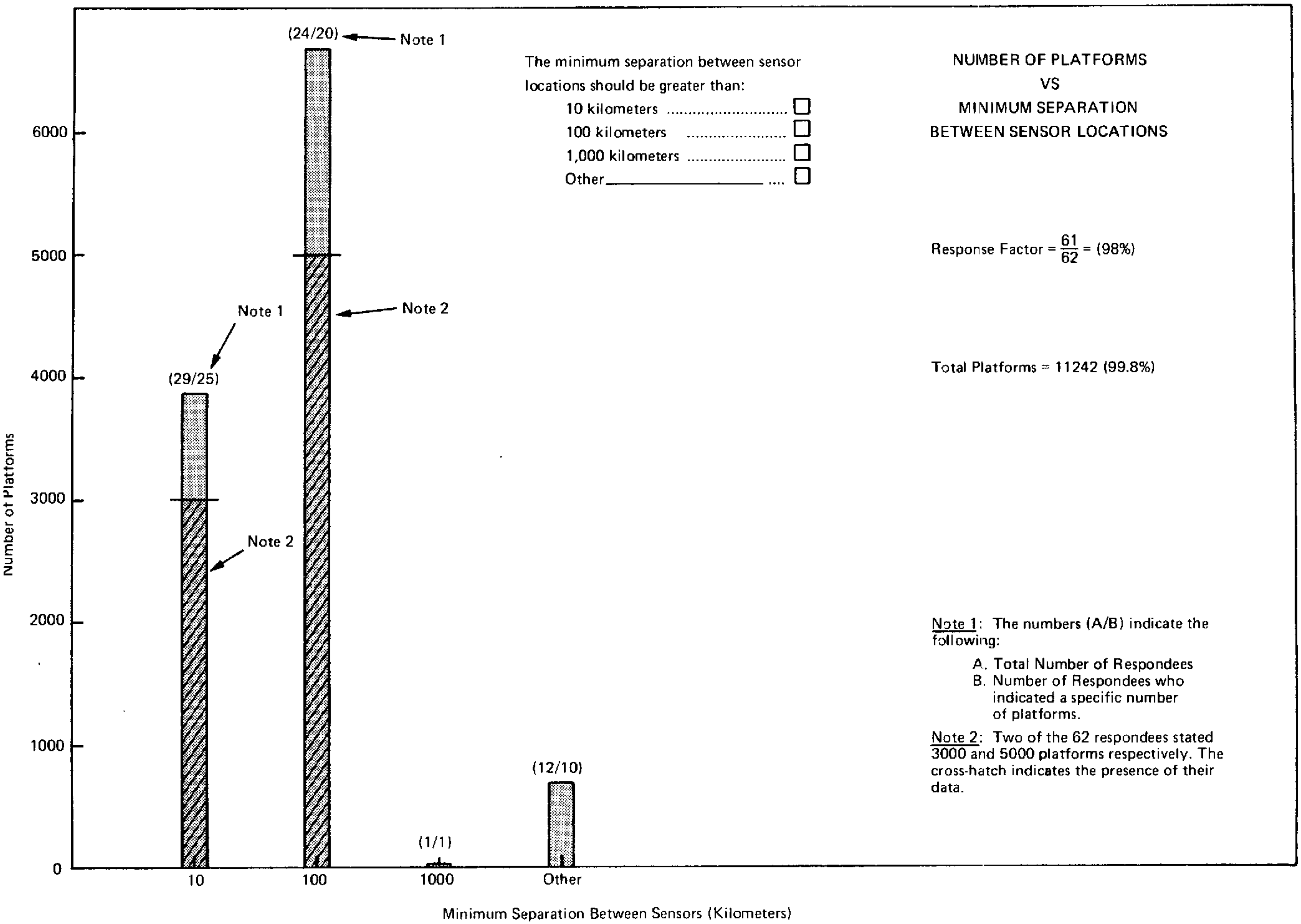

FIGURE 3.22. NUMBER OF PLATFORMS VS MINIMUM SEPARATION BETWEEN SENSOR LOCATIONS

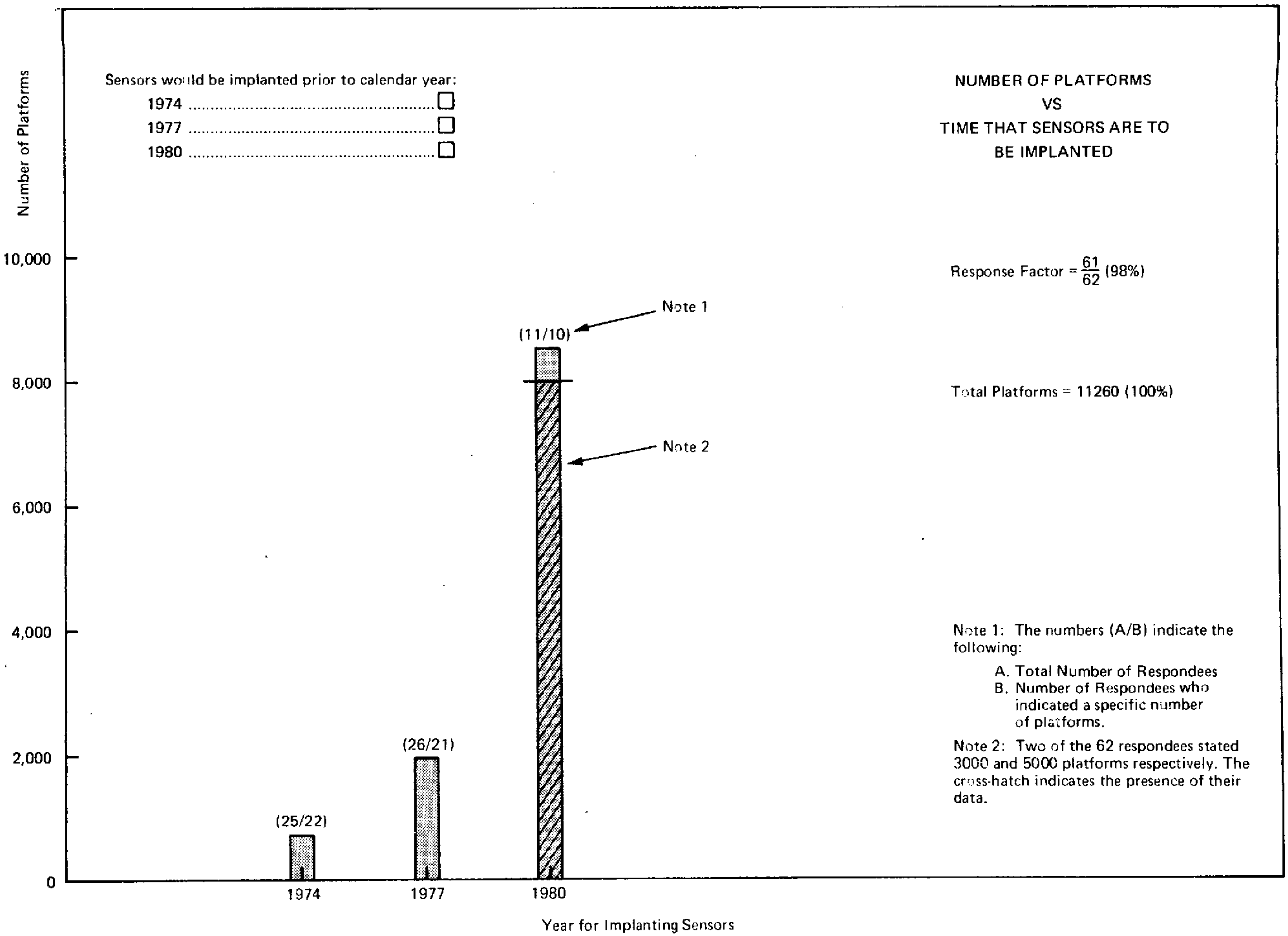

FIGURE 3.23. NUMBER OF PLATFORMS VS TIME OF SENSORS ARE TO BE IMPLANTED

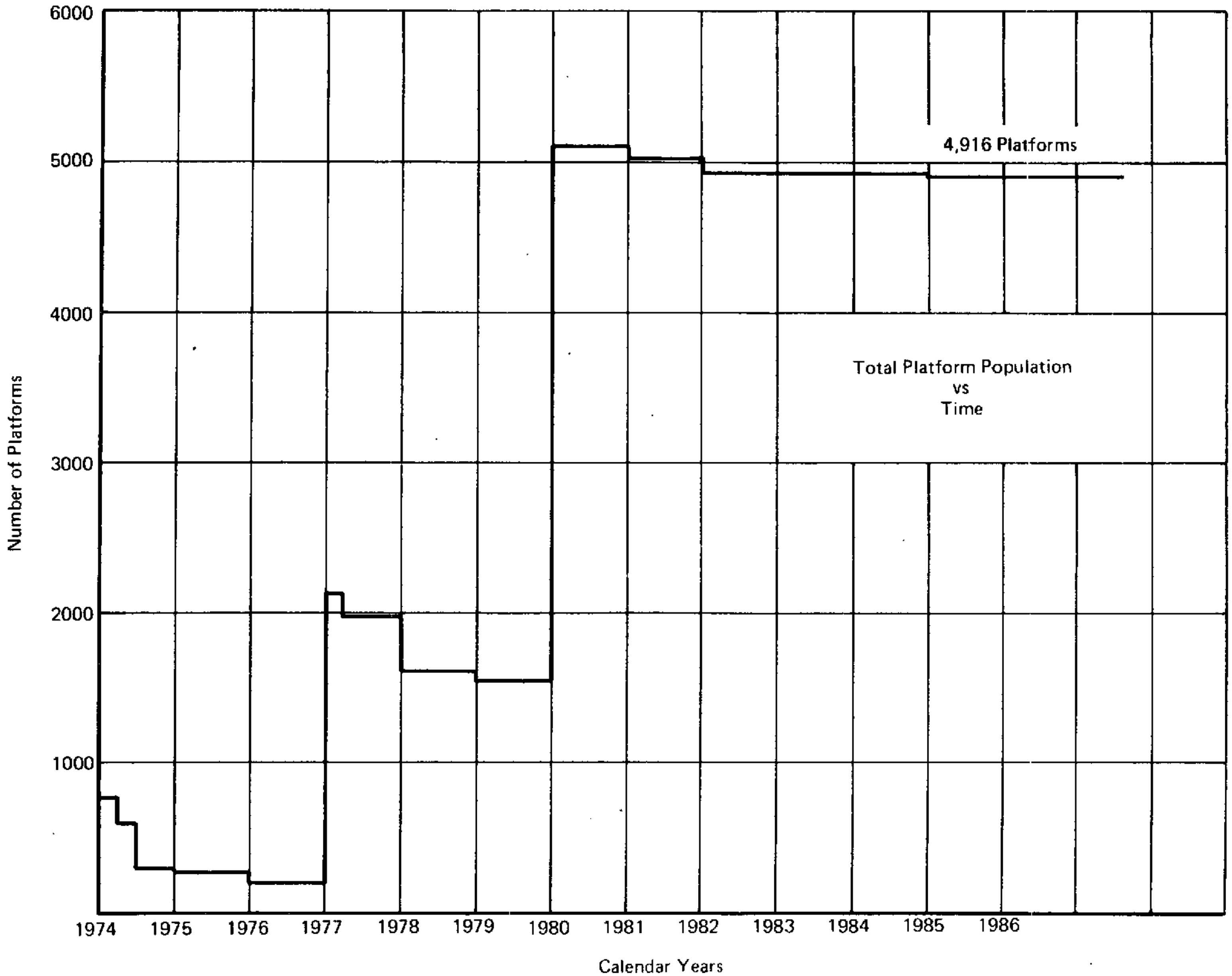

FIGURE 3.24. TOTAL DATA COLLECTION PLATFORM POPULATION VS TIME

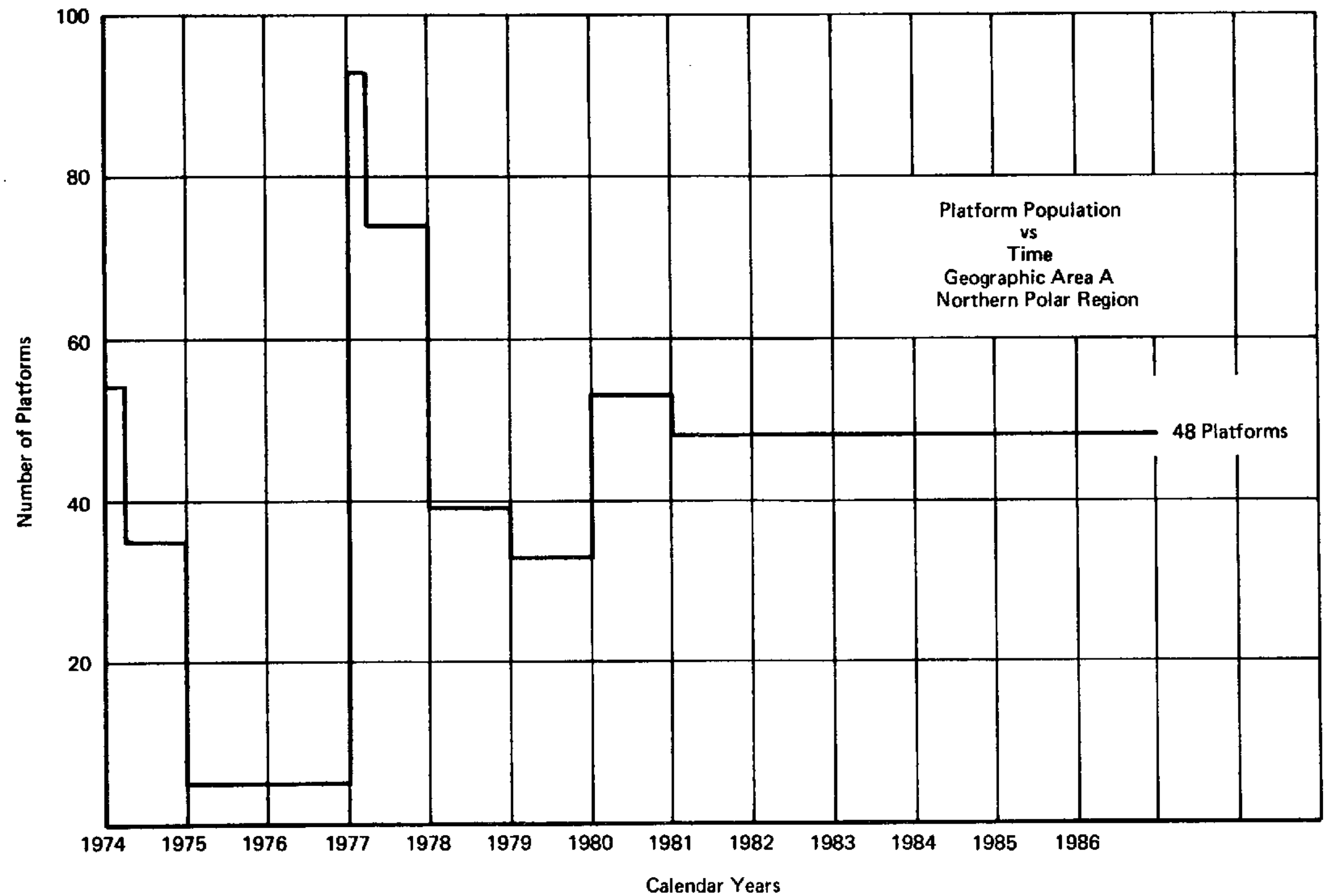

FIGURE 3.25. DATA COLLECTION PLATFORM POPULATION IN AREA A VS TIME

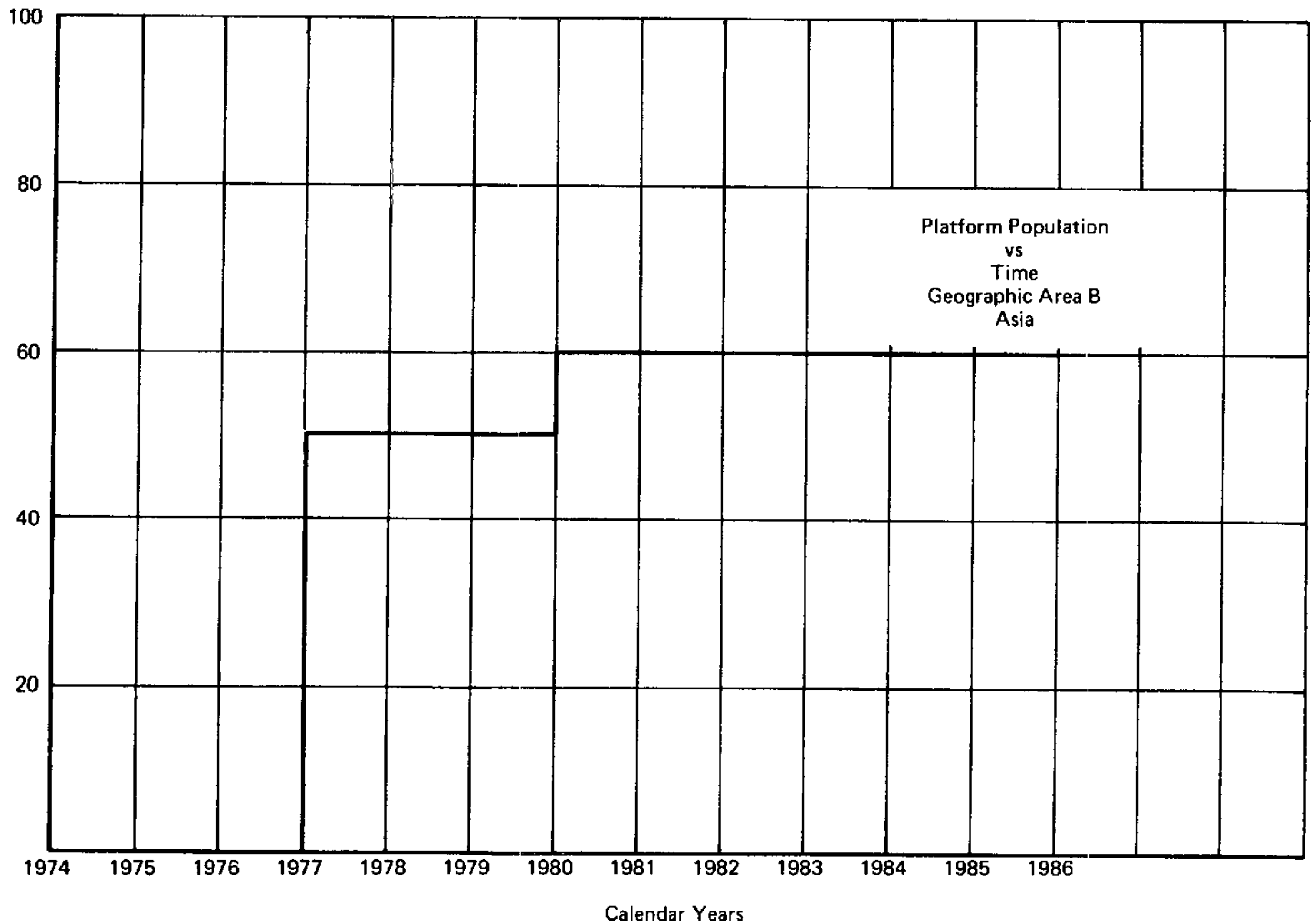

FIGURE 3.26. DATA COLLECTION PLATFORM POPULATION IN AREA B VS TIME

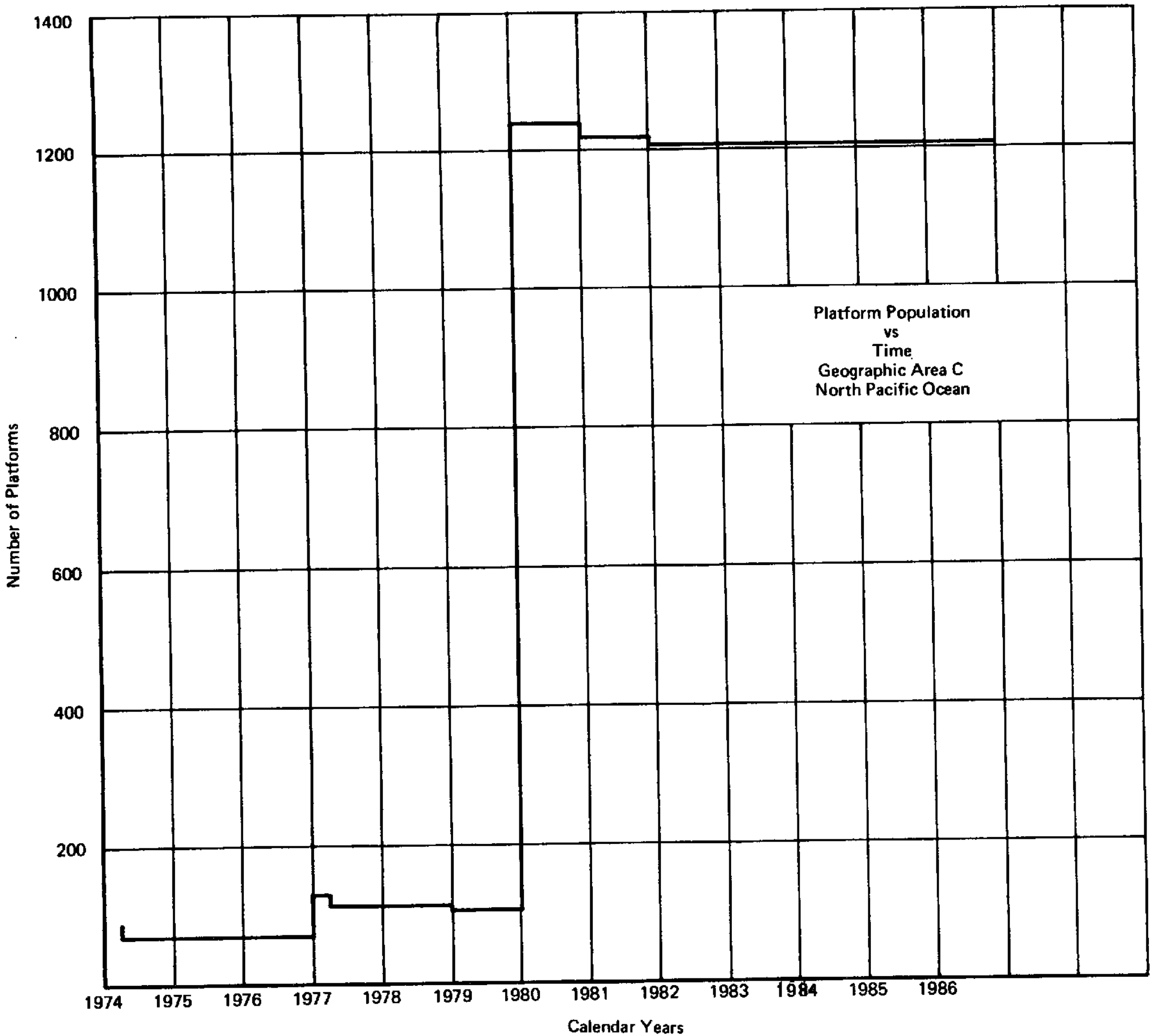

FIGURE 3.27. DATA COLLECTION PLATFORM POPULATION IN AREA C VS TIME

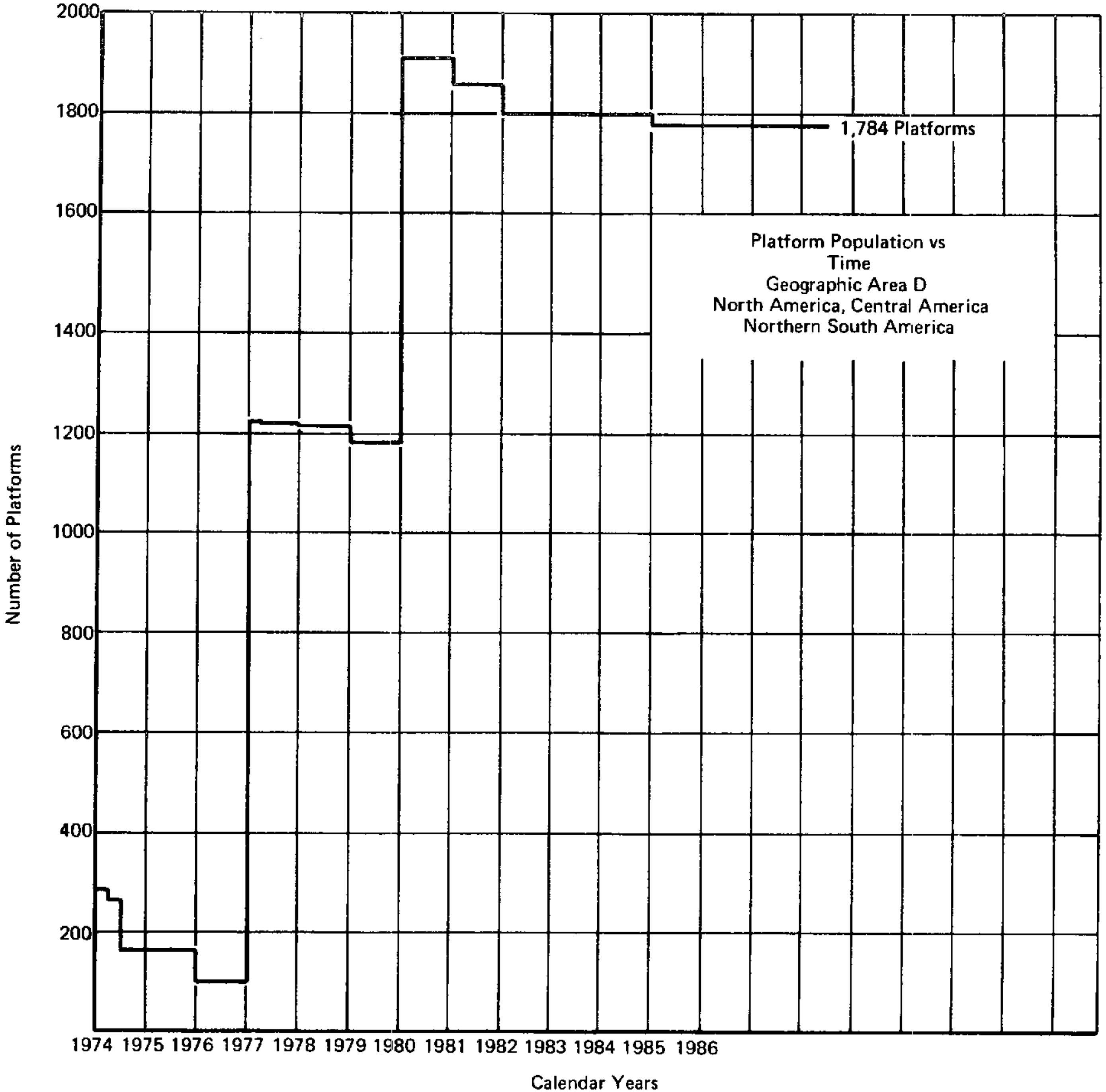

FIGURE 3.28. DATA COLLECTION PLATFORM POPULATION IN AREA D VS TIME

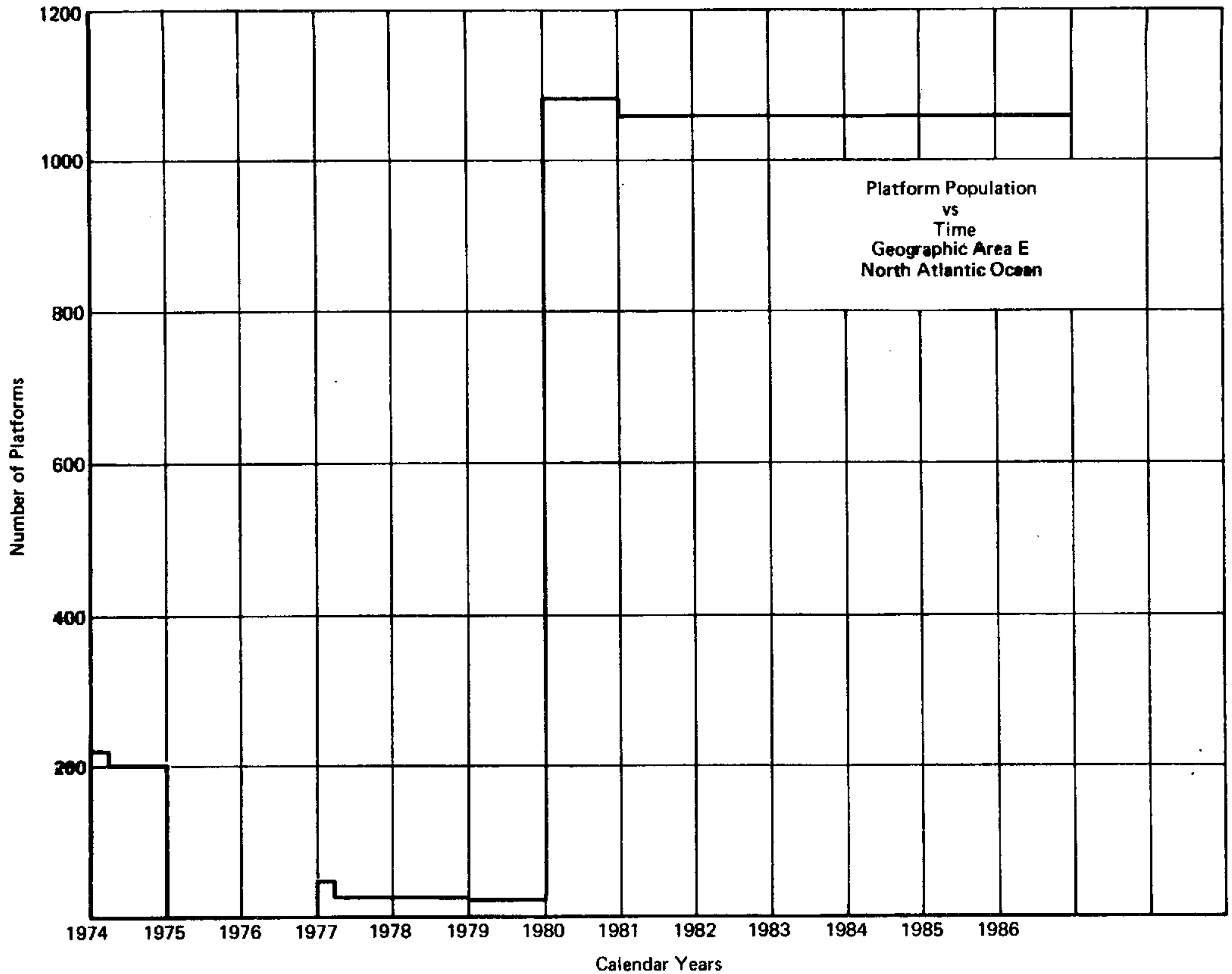

FIGURE 3.29. DATA COLLECTION PLATFORM POPULATION IN AREA E VS TIME

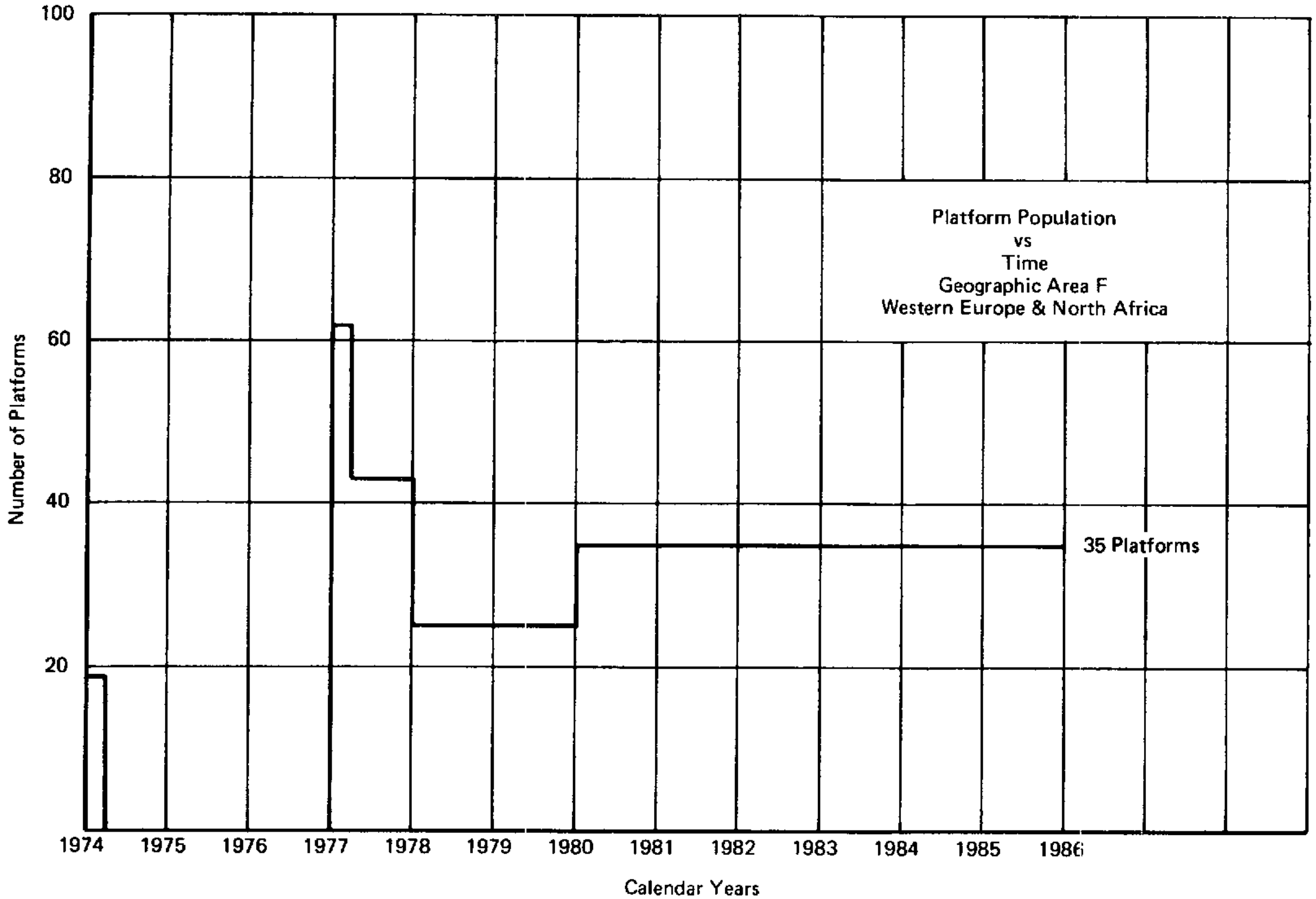

FIGURE 3.30. DATA COLLECTION PLATFORM POPULATION IN AREA F VS TIME

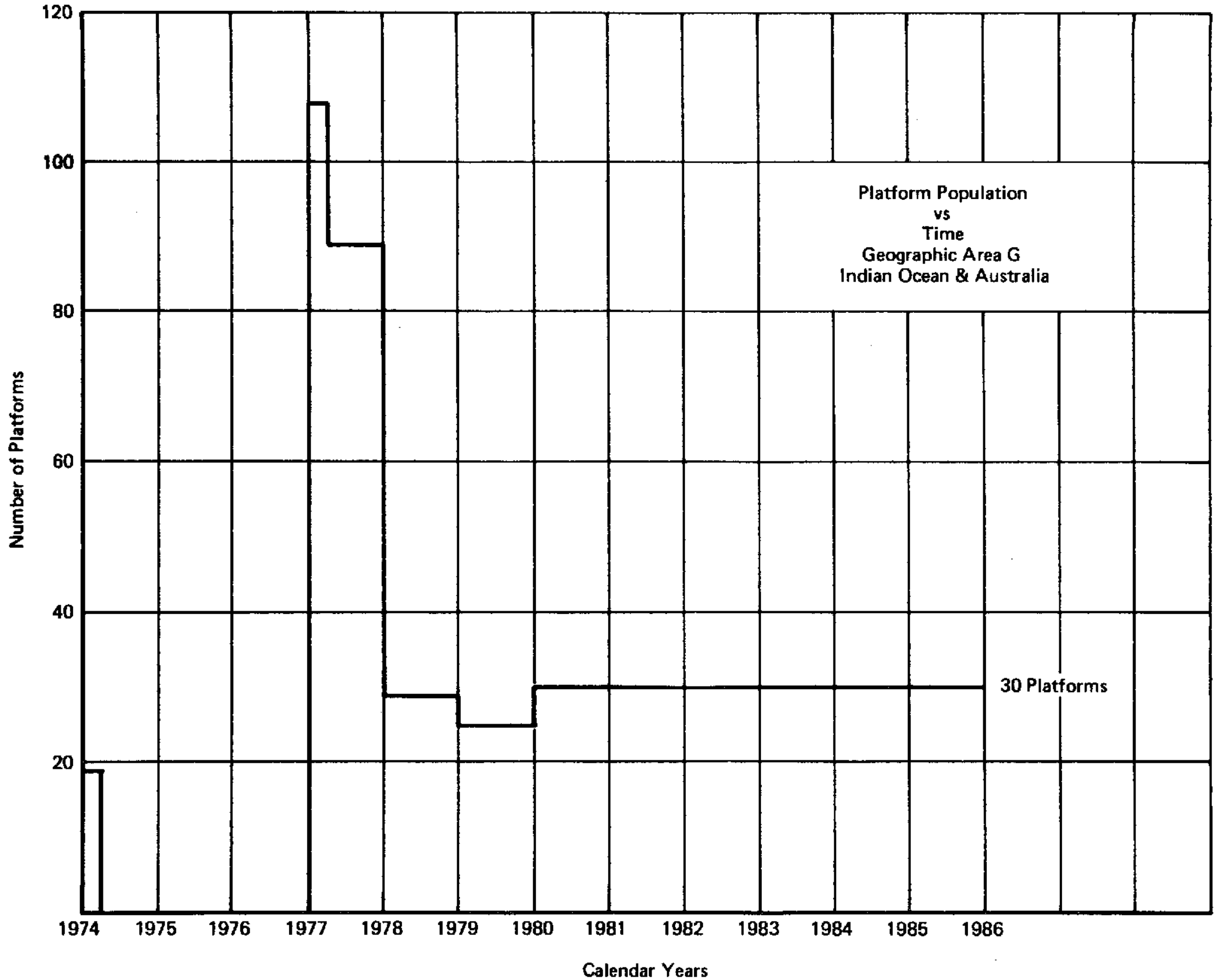

FIGURE 3.31. DATA COLLECTION PLATFORM POPULATION IN AREA G VS TIME

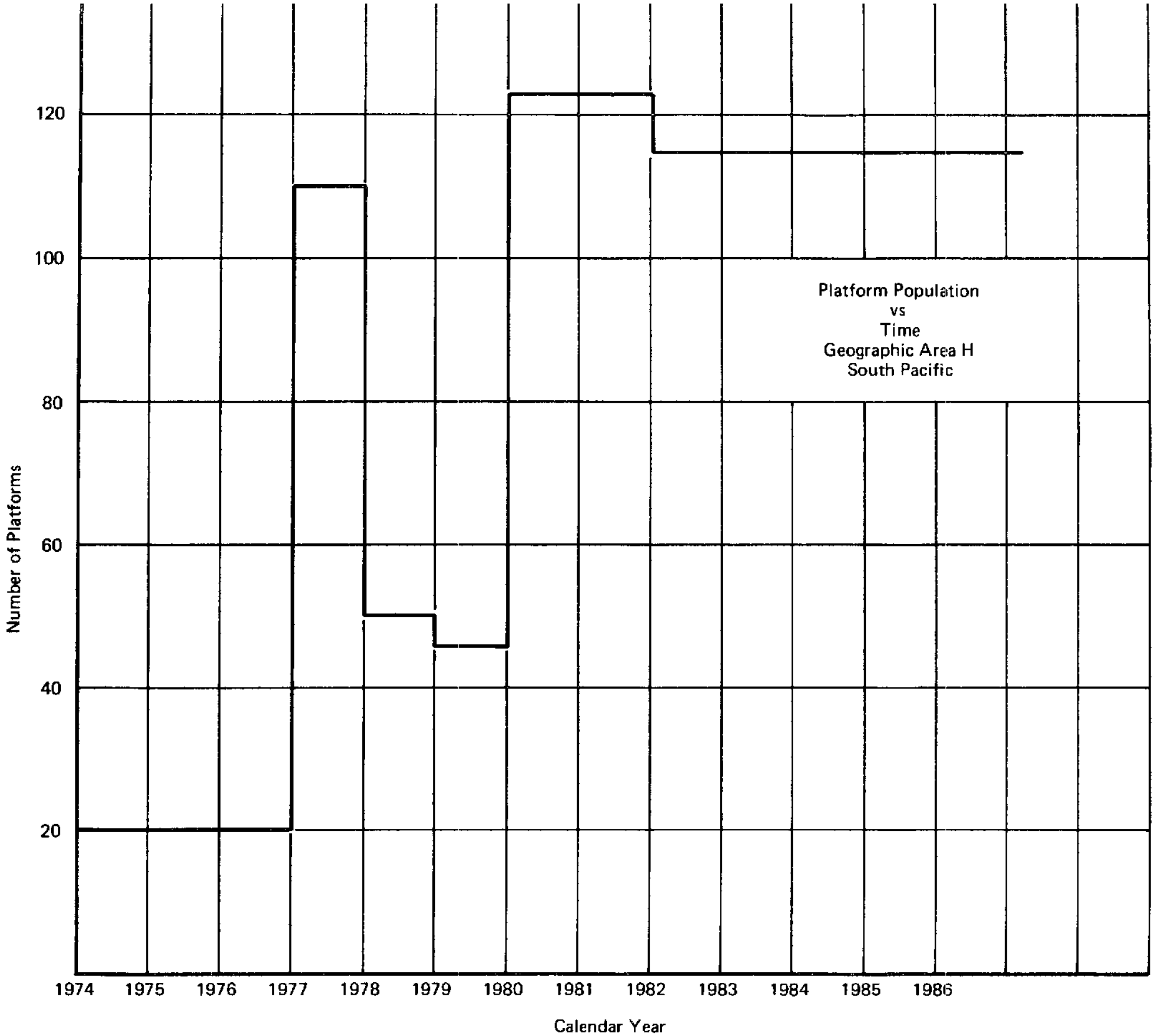

FIGURE 3.32. DATA COLLECTION PLATFORM POPULATION IN AREA H VS TIME

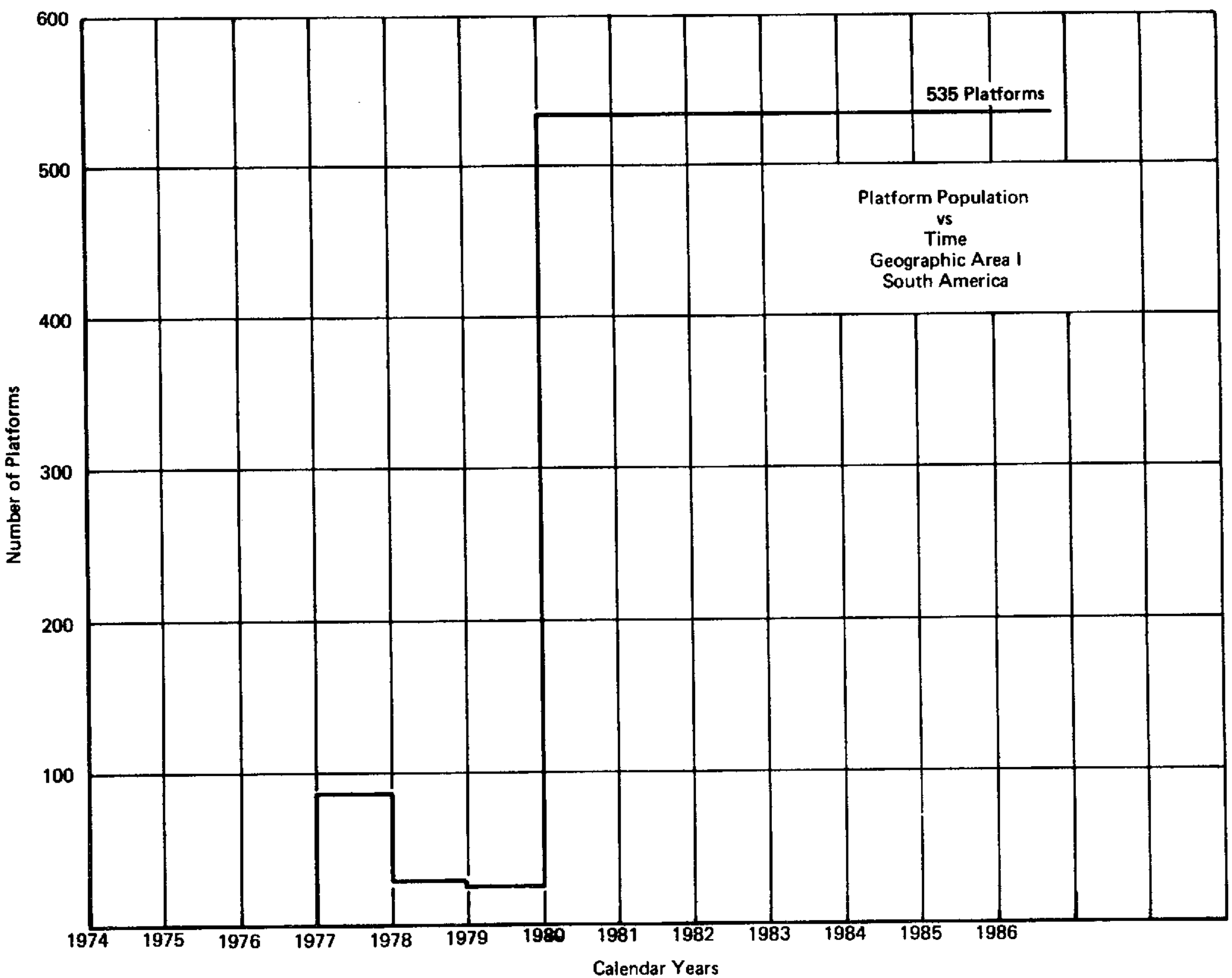

FIGURE 3.33. DATA COLLECTION PLATFORM POPULATION IN AREA I VS TIME

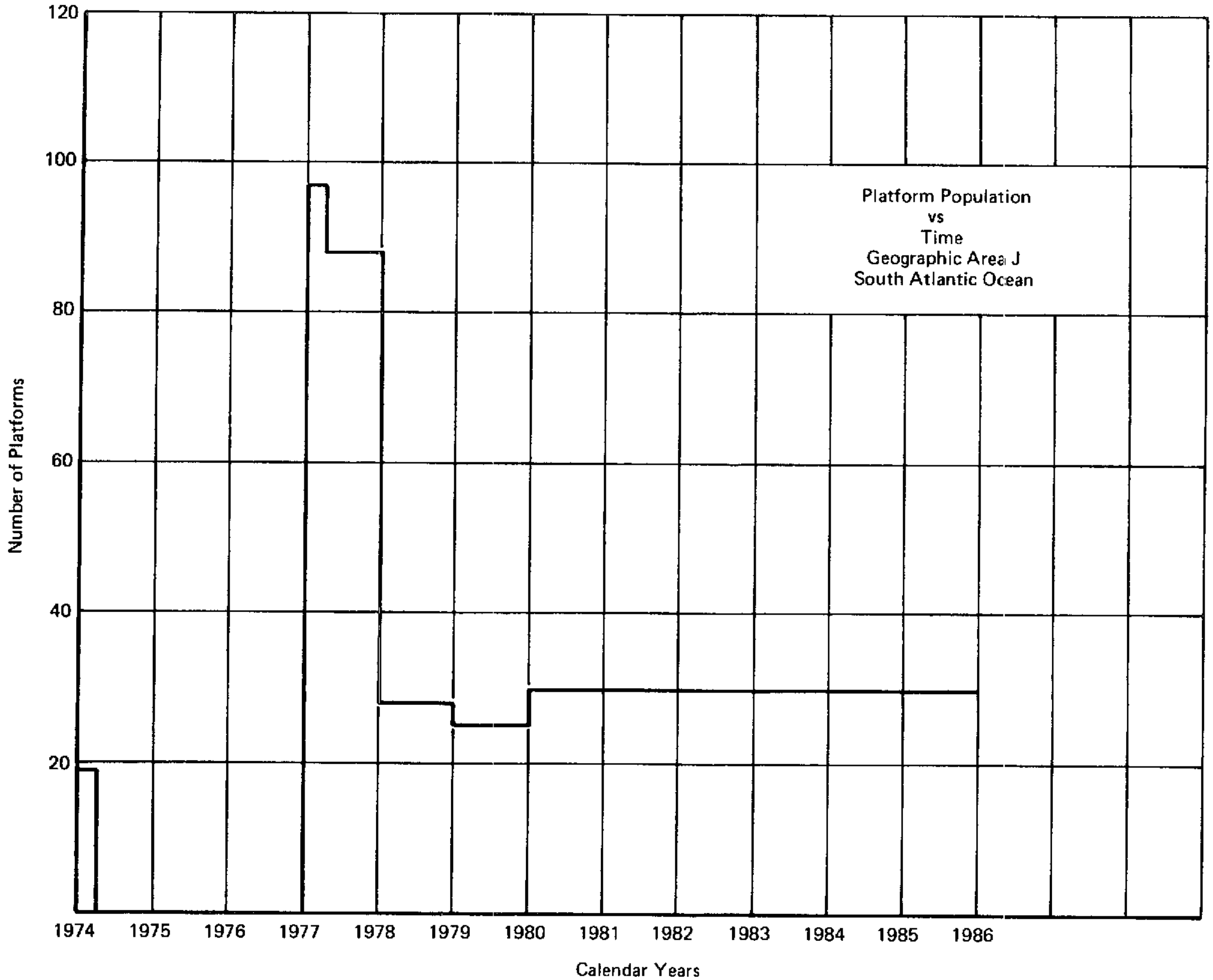

FIGURE 3.34. DATA COLLECTION PLATFORM POPULATION IN AREA J VS TIME

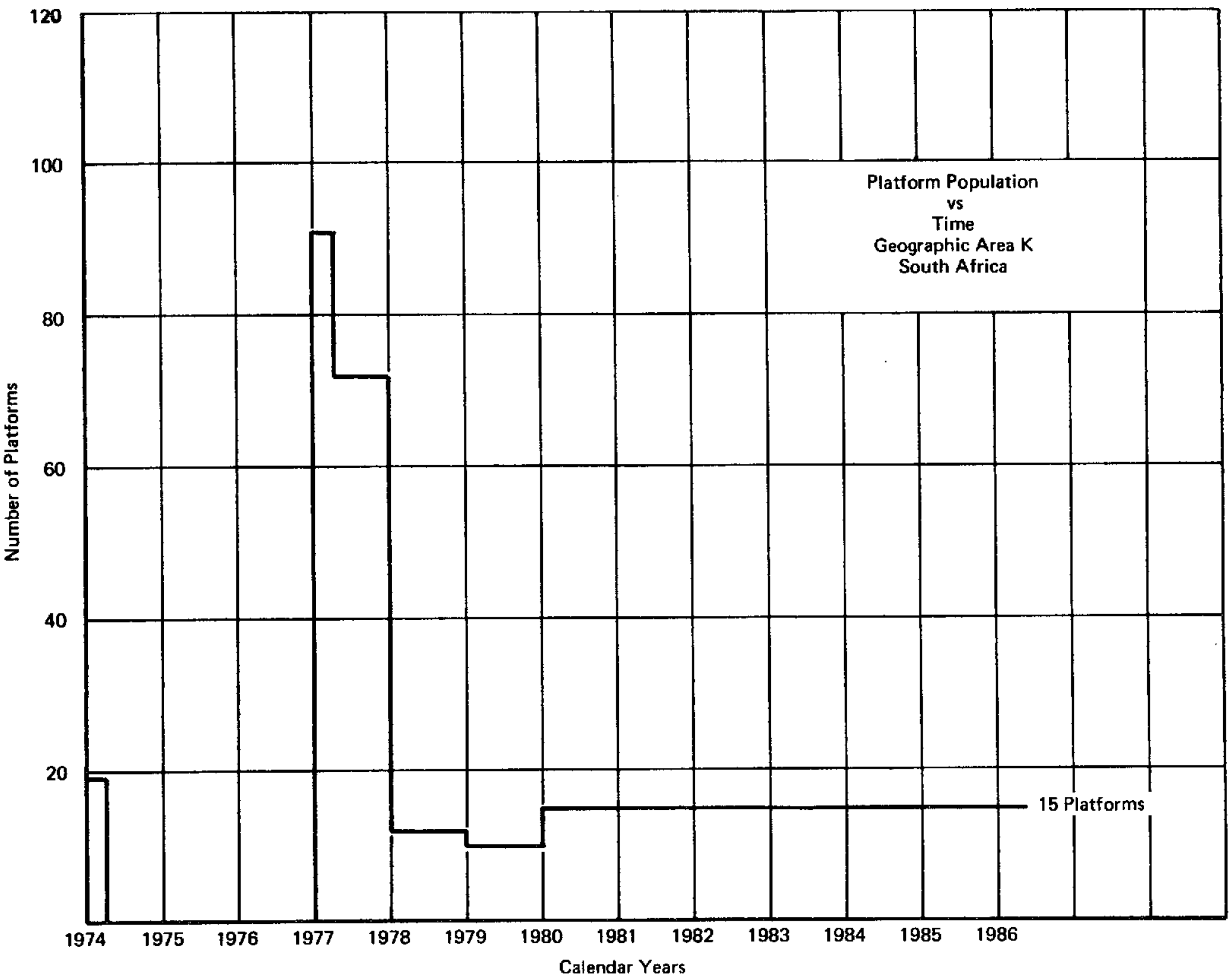

FIGURE 3.35. DATA COLLECTION PLATFORM POPULATION IN AREA K VS TIME

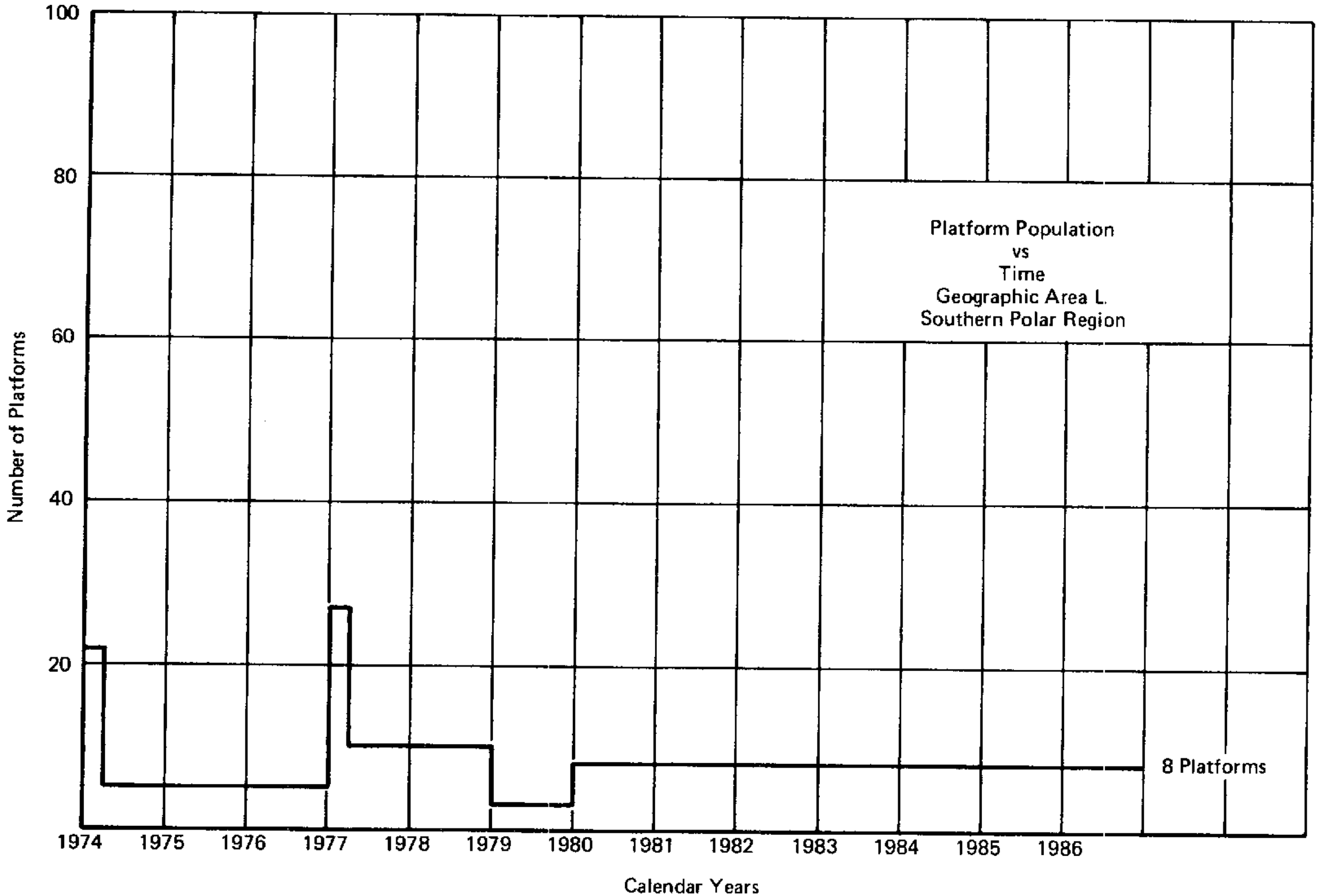

FIGURE 3.36. DATA COLLECTION PLATFORM POPULATION IN AREA L VS TIME

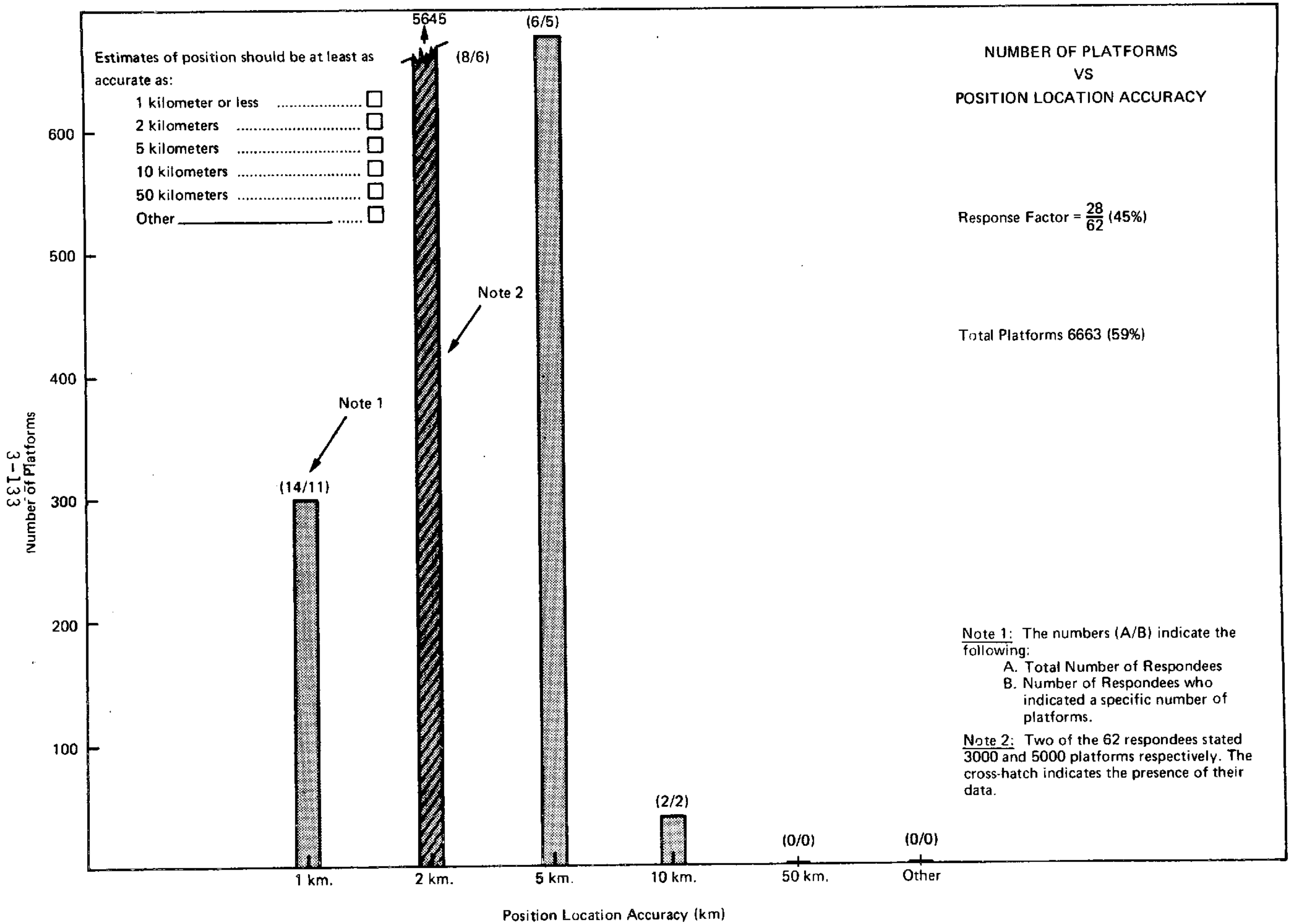

FIGURE 3.37. NUMBER OF PLATFORMS VS POSITION LOCATION ACCURACY

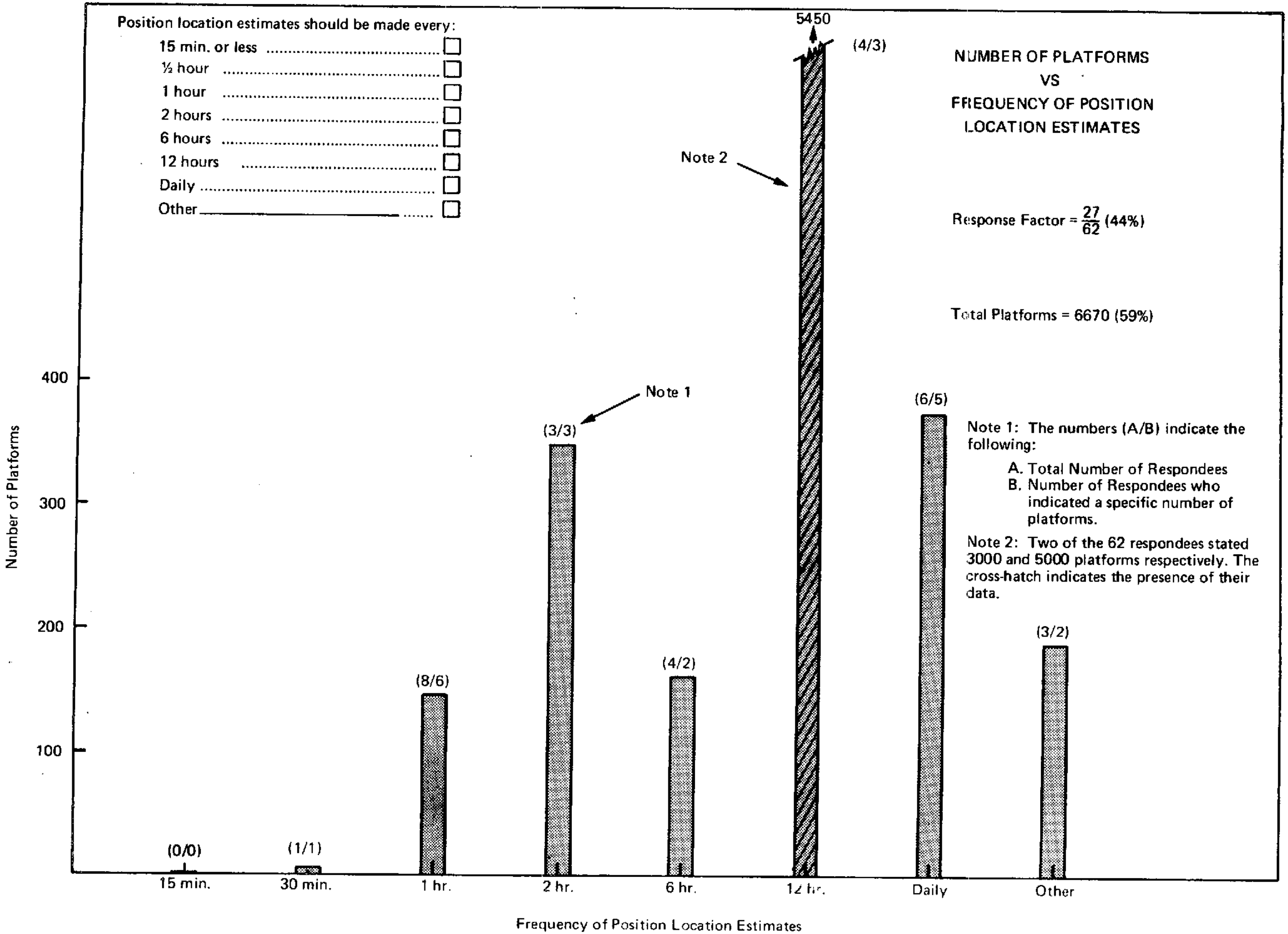

FIGURE 3.38. NUMBER OF PLATFORMS VS FREQUENCY OF POSITION LOCATION ESTIMATES

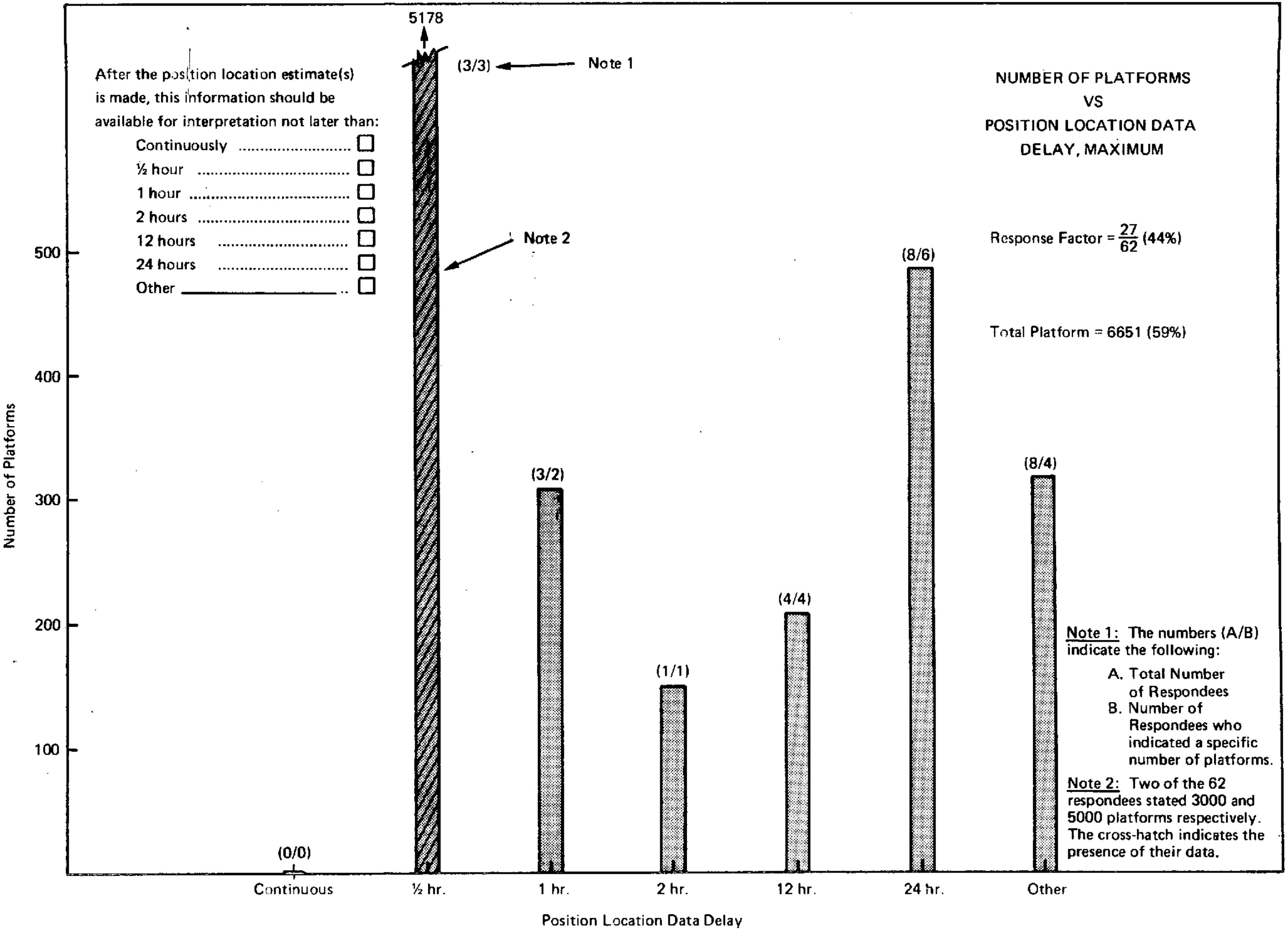

FIGURE 3.39. NUMBER OF PLATFORMS VS POSITION LOCATION DATA DELAY, MAXIMUM

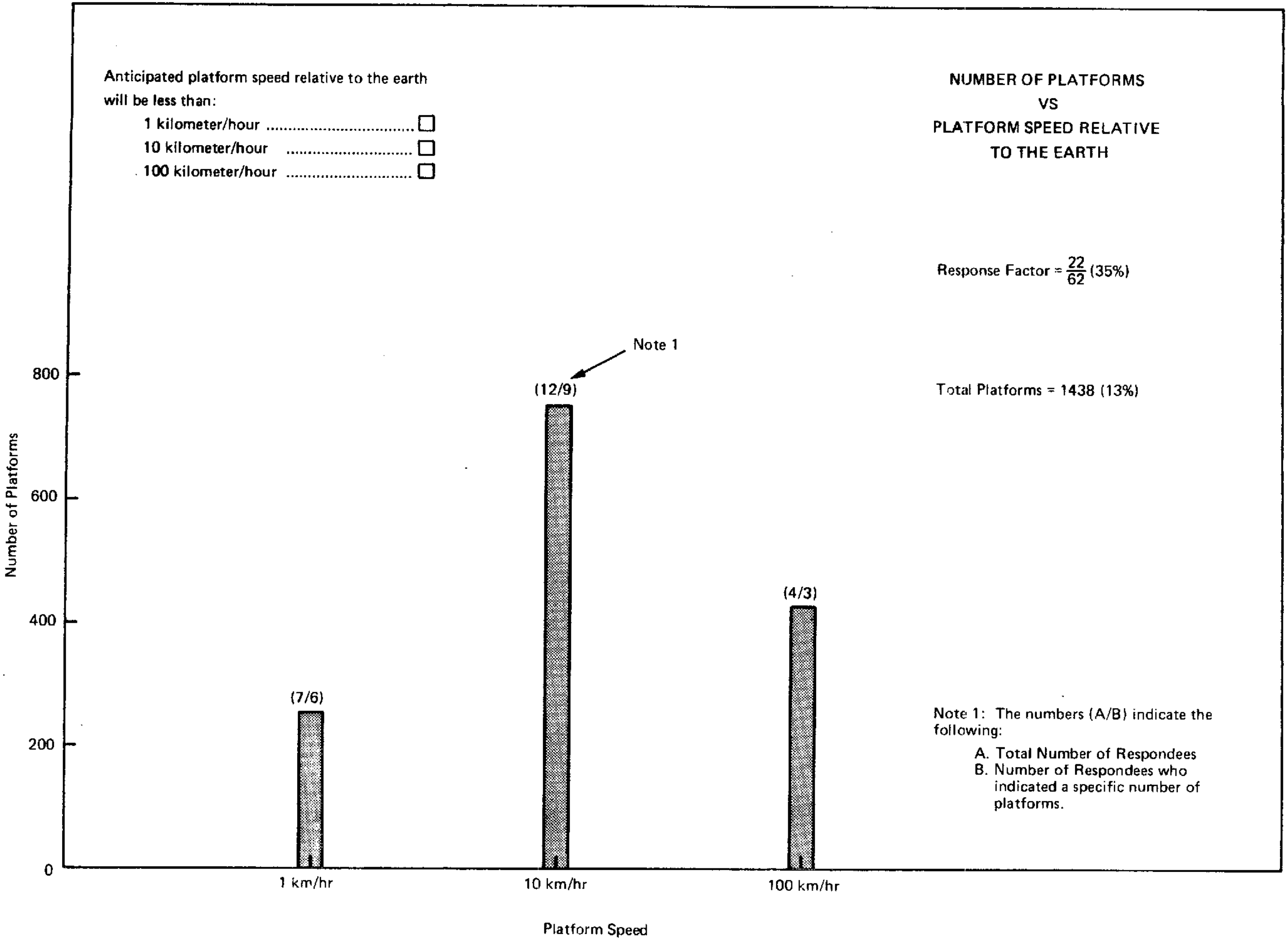

FIGURE 3.40. NUMBER OF PLATFORMS VS PLATFORM SPEED RELATIVE TO THE EARTH

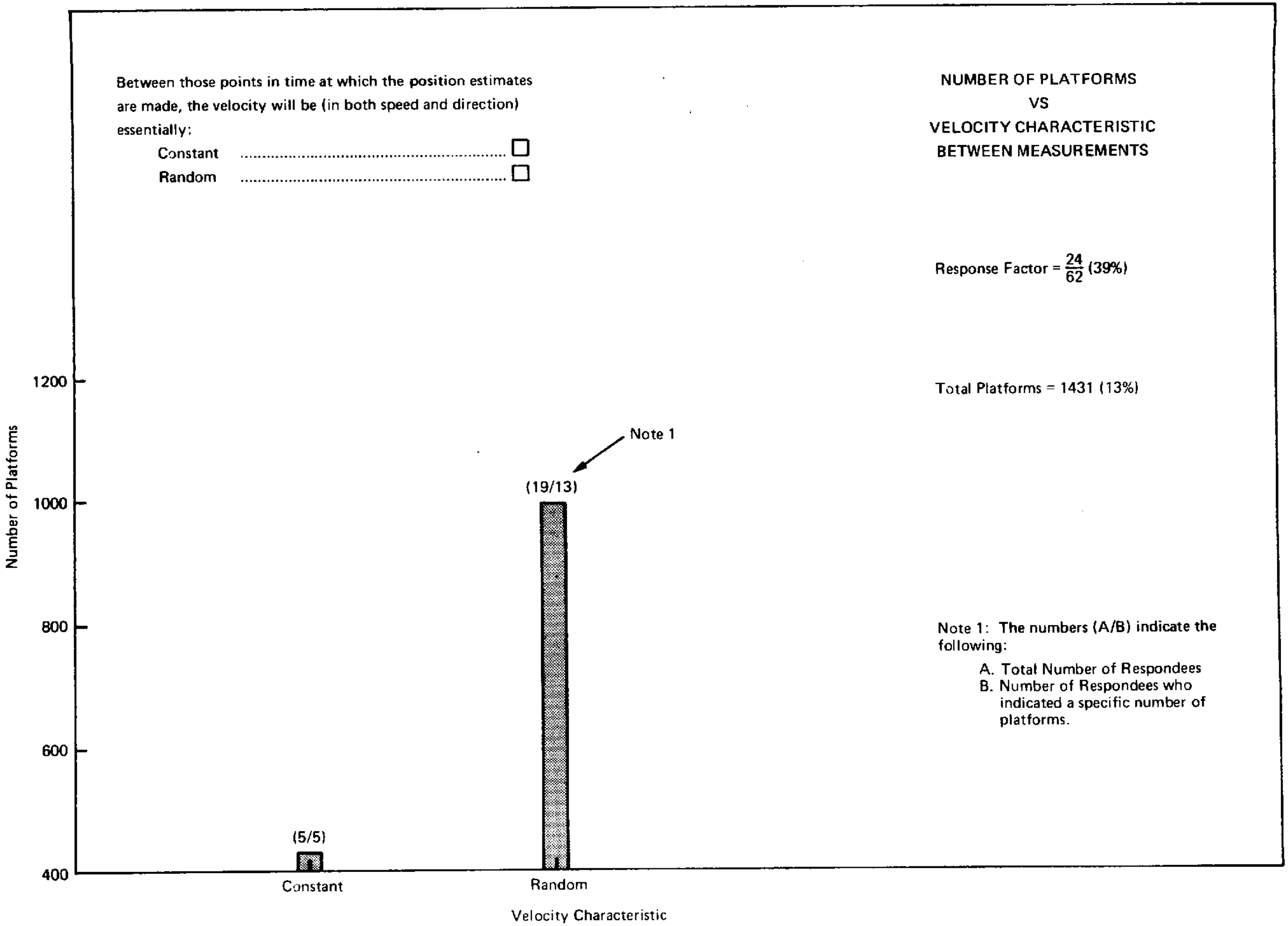

FIGURE 3.41. NUMBER OF PLATFORMS VS VELOCITY CHARACTERISTICS BETWEEN MEASUREMENTS

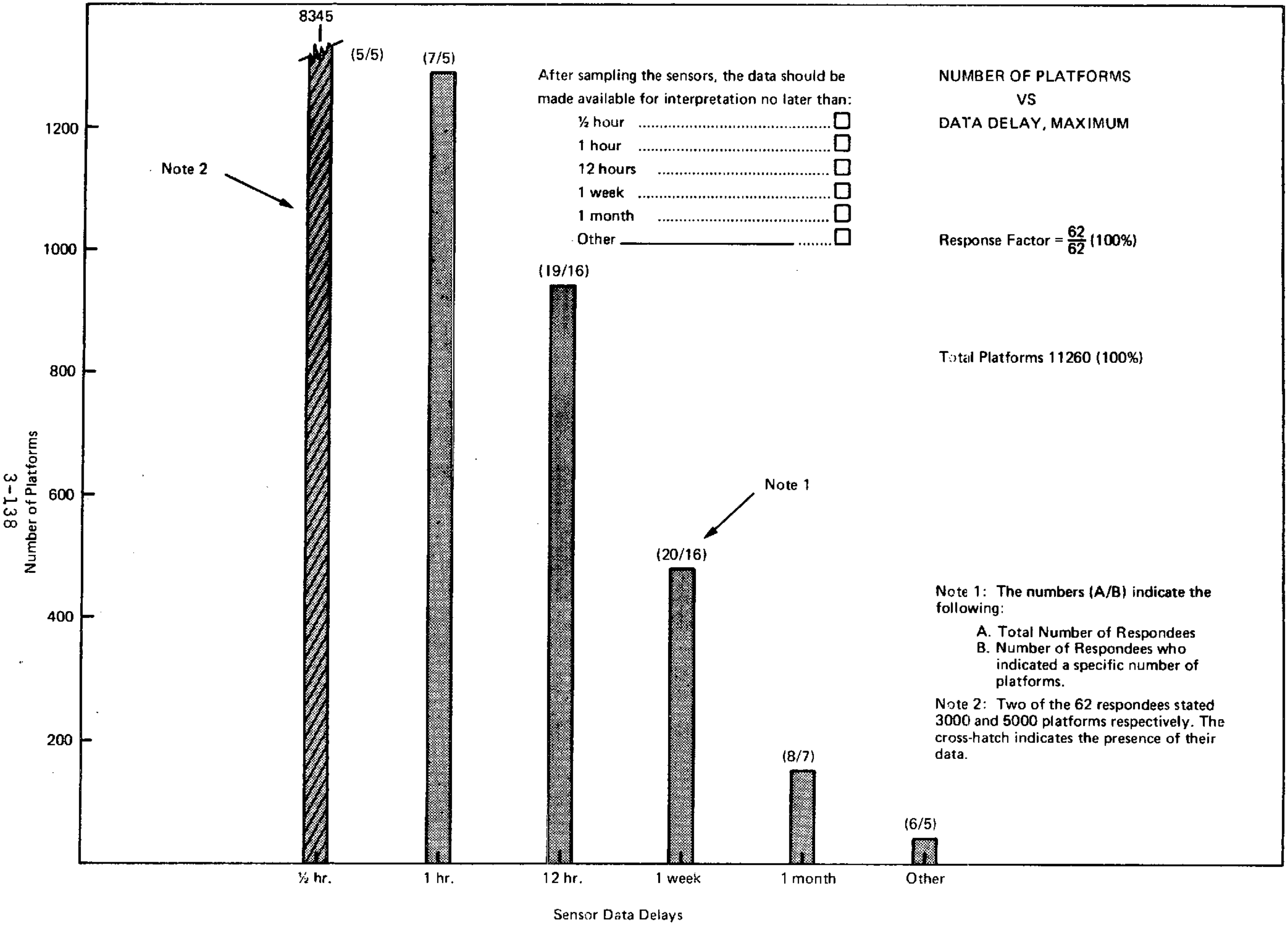

FIGURE 3.42. NUMBER OF PLATFORMS VS DATA DELAY, MAXIMUM

IV. USER REQUIREMENTS

4.1 INTRODUCTION

In this section, the survey data given in Section III is examined and interpreted to determine the general characteristics of data collection requirements within the Data Collection User Community. In particular, specific requirements models are derived for both the data collection platform and the data collection system. Also, the relationship between existing and planned programs and the user requirements is examined; the possibility of satisfying user requirements by means other than satellite is discussed; and new technology requirements are presented.

The requirements models derived are based on user demand in terms of number of users desiring a particular parameter and number of platforms associated with a particular parameter. Also, the requirements as related to different areas of user interest (e.g., agriculture, meteorology, etc.) are presented.

4.2 USER REQUIREMENTS MODEL

The user survey data has been presented in Section III. The data in the form given in Section III is the most general form of a requirements model. The intent in this section is to attempt to refine and condense this data into a more concise requirements model. It should be kept in mind that if the requirements are made more specific, then by necessity a certain percentage of users will be excluded from the model.

In this section, user requirements models based on the survey data will be considered in two forms. A model based on user demand as measured by number of users and number of platforms will be synthesized. Also requirements as related to various areas of user interest (e.g., Meteorology, Agriculture, etc.) will be discussed. Requirements for a Data Collection Platform as well as a Data Collection System will be presented and discussed. The basic elements of the requirements model for the Data Collection Platform and the Data Collection System are shown in Tables 4.1 and 4.2.

In reviewing the requirements models to be presented, the reader should be aware of the context and applicability of the model. As stated previously the data presented in Section III is a requirements model in its most general form. The intent of this section is to refine this data and to generate a more specific model which is more than a summary of the data in Section III. As will be seen, this is a difficult task since at present there are no real world constraints to help eliminate certain values associated with a particular requirement. That is, at this point in time we are not attempting to meet the requirements with a specific system. Instead, the starting point is the requirements and without any external constraints (e.g., the specifications of a particular system) it is difficult to narrow down the model.

Figure 4.1 presents a block diagram which will aid in understanding the context and relevence of the models derived in this section. As shown in the figure, the starting point is the survey data which in turn results in a preliminary requirements model which is the data as presented in Section III of this report. The next step is to review the requirements to determine if any of the user requirements are beyond the technical state-of-the-Art. This was done in the sections which follow along with a certain amount of interpretation to yield the new requirements model shown in the figure. No further condensing of the requirements is possible without performing the next steps shown in the figure. The exercise of designing systems or platforms to meet the user requirements and considering existing or planned systems to meet the user requirements will yield a set of "real world" constraints such as cost, operational feasibility, schedules, implementation characteristics and so on. These constraints will call for the elimination of parts of the user requirements for various reasons. For example, the more flexible and broad a requirement is the more expensive is the system of equipments required to satisfy the requirement. At this point

TABLE 4.1

DATA COLLECTION PLATFORM REQUIREMENTS

Communications/Data Collection Capability	Position Location Capability	Environmental Conditions	Platform Physical Characteristics	Platform Type	Platform Reliability	Platform Cost
• Number of Platforms per User • Number of Sensors per Platform • Decimal Precision of Data • Analog Sensor Voltage Range • Digital Sensor Bits per Measurement • Synoptic Period • Bit Rate for Continuous Transmission • Is Platform Commandable/ Interrogateable?	• Is Position Location of the Platform Required?	• Environmental Temperature Range • Other Environmental Conditions	• Platform Weight • Platform Size • Platform Orientation Limits • Allowable Platform Protrusions • Platform Construction Characteristics	• Buoy • Balloon • Animal • Fixed Site • Other	• Expected Life Life of Platform	• User Cost Estimate

TABLE 4.2

DATA COLLECTION SYSTEM REQUIREMENTS

Communications Capability/ Capacity	Position Location Capability	Geographic Disposition of Platforms	Time Frame	Data Dissemination
• Number of Platforms per User • Platform Population vs Time • Number of Sensors per Platform • Decimal Precision of Data • Digital Sensor Bits per Measurement • Synoptic Period • Bit Rate for Continuous Transmission • System Capacity • Is Platform Commandable/ Interrogateable?	• Is Position Location Required? • Position Location Accuracy • Position Location Rate • Position Location Data Delay • Platform Speed • Platform Acceleration Between Measurements	• Geographic Area vs Number of Platforms • Distance Between Platforms	• Time of Implementation • Duration of Operation (Expected life)	• DCP Data Delay • Position Location Data Delay

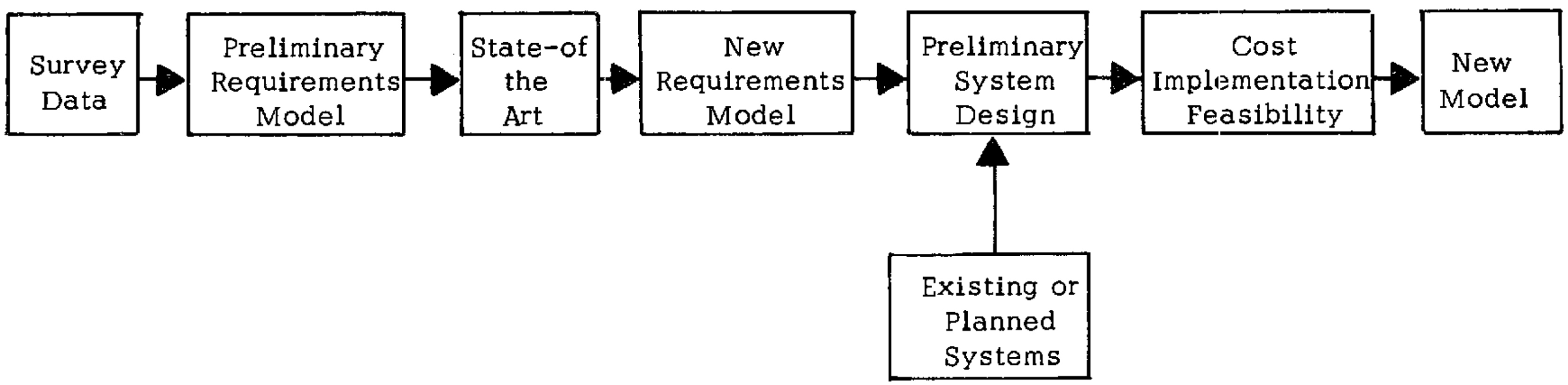

FIGURE 4.1. CONTEXT AND APPLICABILITY OF REQUIREMENTS MODEL

with these constraints, a designer could use the user demand as a criteria for eliminating parts of the requirement. The net result would be a new requirements model, which in the system designers opinion can be satisfied. This new (and final) model would by necessity not satisfy all the requirements of all the users. No single system can do this.

4.2.1 Requirements Based on Overall Demand

In Section 3.3 of this report, the survey data is plotted versus the number of platforms and number of users. Both of these factors indicate user demand for a particular requirements parameter. A requirements model for a data collection platform and a data collection system will now be derived using this data.

4.2.1.1 Data Collection Platform Requirements Model

Using Table 4.1 as a guide, the first major element of the user requirement for a data collection platform is the Communications and Data Collection capability as expressed by the parameters listed.

Number of Platforms per User: The survey data indicated a wide variety of desires for this parameter. Figure 3.1 shows the distribution of user demand for platforms. Table 3.56 shows even more dramatically the dispersion of user desires by showing the number of respondees for various numbers of platforms. Based on this data it would be unrealistic to project a specific number for the Number of Platforms per User. An alternative is to specify a range of values that a system designer could anticipate with a high degree of confidence. The data shows that 94.9% of the respondees desire anywhere from one to three hundred platforms. This then would be a statement of the user requirements for number of platforms

Number of Sensors per Platform: In the questionnaire, the user was given a choice for this parameter as shown in Figure 3.2. If one is forced to specify a particular number for this parameter, eight sensors per platform would be the number. If eight sensors are used, the requirement for (88.38% of the platforms) is satisfied. Note that those users indicating 16 sensors could conceivably use two platforms each with eight sensors.

Decimal Precision of Data: In the questionnaire, the user was given a choice of three values for decimal precision as shown in Figure 3.3. Even though 2 digit accuracy corresponds to the highest percentage of platforms (67.97%), the demand for the other values is too significant to ignore. That is, 32.25% of the users want 2 digits, 38.71% of the users want 3 digits, and 24.19% of the users want 4 digits. This is a relatively uniform demand. The conclusion then is that the decimal precision of the data will be 2,3, or 4 as opposed to one specific value.

Analog Sensor Voltage Range: In the questionnaire, the user was given a choice of two values for voltage range and an option to indicate "other" voltage ranges as shown in Figure 3.4. Demand for both voltage ranges is too significant to ignore. thirty-eight percent of the users (75.47% of the platforms) indicated a 0 to 5 volt range. Twenty-seven percent of the users (7.46% of the platforms) indicated a -10 to +10 voltage range. If one is forced then to state specific values for this parameter, based on the survey data two voltage ranges must be accomodated (i.e., 0 to 5 v and - 10 to + 10 v). This of course excludes certain of the users. Also, since the response factor to this question was marginal (81%), one must anticipate possible changes in the specification of this parameter.

Digital Sensor Bits per Measurement: Those users who intend to use digital sensors were asked to specify how many bits per sensor measurement they anticipated. Table 3.59 in summarizing Figure 3.5 shows that several values were given by the users and that the distribution of users among these values is fairly uniform. In terms of platforms, 4 bits corresponds to the majority of the platforms (48.14%). Even with this majority at 4 bits, the uniformity among the users demands that this number be a variable in the requirement. Thus for the baseline model, Digital Sensor Bits per Meaxurement will be a variable in the range 4 to 48 bits.

Synoptic Period: In the questionnaire the user was asked how often he wanted a sensor measurement or equivalently what his synoptic period was. Another way of looking at this requirement is that the user wants a sensor measurement record, with at least one measurement per synoptic period. Figure 3.6 gives the survey data for synoptic period. Table 3.60 summarizes the data. As indicated in Table 3.60, the demand based on the number of platforms does not coincide with the demand based on the number of users. Also, the demand for any single value is not really negligible using number of users or number of platforms as a criteria. Thus, for the baseline requirement, Synoptic Period is considered to take on a range of values from Continuous to 24 hours.

Bit Rate for Continuous Transmission: Some users of a satellite data collection system will require continuous monitoring of their sensors in real time. These users were asked to specify the data rate that they anticipated transmitting from the platform to meet their requirement. Figure 3.7 presents the questionnaire data on this question. As one would anticipate, the response factor is low since not all the users require a continuous synoptic period. It should be noted here that some users without continuous synoptic periods answered this question thereby reducing the credibility of the results. Assuming that a given bit rate is satisfactory for slower rates as well, the data shows that a rate of 1000 BPS will satisfy the majority of users in this category and is therefore chosen as the value for the baseline requirements model. Note that transmitting at 1000 BPS continuously constitutes a very large amount of data and rates beyond this value are not considered necessary except for imagery. The users then in the model are given the benefit of the doubt that they do indeed need such a high bit rate.

Is Platform Commandable/Interrogateable?: Like the previous items, this question will effect the design of a data collection platform since the inclusion of this capability requires a receiver in the platform. The survey data for this question is given in Figure 3.8. The Response Factor (90%) is considered high enough to make the data valid. As indicated in the figure, the user was asked if he considered the capability unecessary, Desireable or Mandatory. As indicated, only 4.84% of the users (3.35% of the platforms) considered the capability mandatory. With this as a criterion, one could say that the requirement could be ignored without significant impact. On the other hand, a significant number of users (53.22% ~ 36.1% of the platforms) state that such a capability is desireable. If one concludes that "desireable" and "mandatory" mean the same thing then the conclusions is that 39.45% of the platforms will have this capability and the requirement will be so stated. On the other hand, the response does indicate a flexibility in backing off on this requirement assuming "desireable" means the user can really do without such a capability.

The second major element of the data collection platform requirements model (as shown in Table 4.1) is Position Location Capability.

Is Position Location of the Platform Required?: If the Data Collection System is to locate the position of a platform in addition to collecting data from it, the platform may require additional circuitry to aid in this function. For this reason the existence of this capability will effect the design of the platform. The survey data for this question is given in Figure 3.9. The Response Factor was very low because the questionnaire instructions stated that the user should ignore the question of position location if he did not require such a capability. With this in mind the "desireable" category becomes negligible and a relatively even distribution between "unnecessary" and "mandatory" results. For purposes of the requirements model then, the conclusion is that 38.71% of the users (21.42% of the platforms) will require position location.

The next major element of the data collection platform requirements is the specification of the environmental conditions to which the platform will be subjected. There are two categories associated with this specification as shown in Table 4.1.

Environmental Temperature Range: As indicated in the survey data in Table 3.62 and Figures 3.10 and 3.11, 14 separate temperature ranges were specified by the users. The response factor was very high (97%). Thus the data is considered valid. Using the data in Table 3.62, one can deduce that 83.3% of the platforms could operate in the temperature range

$-100^{o}F$ to $+100^{o}F$. Thus for purposes of a specific requirements model the temperature range of $-100^{o}F$ to $+100^{o}F$ could be used. This would exclude 16.44% of the platforms.

Other Environmental Conditions: In addition to environmental temperature, users were asked to indicate other environmental conditions which, if not accounted for, could impair the performance of the data collection platform. The results of this question are given in Figure 3.12. There was a significant response (Response Factor = 92%) to the first three items listed in the questionnaire namely submersion in salt water, submersion in fresh water, and high humidity. Also 11% of the users (9.7% of the platforms) indicated a variety of "other" environmental conditions. These other conditions were" high winds, icing, heavy rains, heavy snow, snow loads, burial, vandal damage, rodent damage, sustained low temperature, sustained high temperature, lightning, high altitude, dry/windy, high seas, rapid temperature change, rapid depth change, interfacing water currents, vibration and impact. The only reasonable way to summarize these requirements for a model is to state that the environmental conditions are varied.

The next major element in the data collection platform requirement is Platform Physical Characteristics. There are five categories associated with this specification as shown in Table 4.1.

Platform Weight: As indicated in the survey data in Table 3.63 and Figure 3.13 a variety of weights are required by the user. The Response Factor is relatively high so the data is considered valid. Note that 24.19% of the users (6.52% of the platforms) desire a weight less than one kilogram (2.2 pounds). It is safe to say that such weights are beyond the state of the art at present*. Thus these weights will be excluded from the model. Of the remaining platforms , 44.44% would have a weight maximum ranging from 1 kilogram (2.2 pounds) to 100 kilograms (220 pounds) and 42.92% of the platforms would have no restriction on weight. Platform weight will be so statet in the requirements model.

Platform Size: As indicated in the survey data in Table 3.64 and Figure 3.14, a variety of sizes are desired by the users. The Response Factor was relatively high (90%) indicating good data. Note that 19.34% of the users (.97% of the platforms) indicated a desire for platforms smaller than the size of an orange. At present such sizes are beyond the state of the art*. These users will be excluded from the model. Of the remaining platforms 37.8% will vary between the size of a grapefruit and the size of a watermelon

---

* It is assumed here that the platforms will transmit data directly to a satellite with no intermediate repeater.

and 53.22% of the users (56.32% of the platforms) indicated "other sizes ranging from 1 cubic foot to no restriction with a large majority (37%) indicating no restriction. A statement of the requirement will be then that platform sizes will vary from a minimum being the size of a grapefruit to no restriction.

Platform Orientation: As indicated in the survey data in Table 3.65 and Figure 3.15, four different orientation limits are specified by the users. The Response Factor was high (95%) indicating good data. The demand for each of the limits is non-negligible even though there appear to be definite preferences. Since there is no negligible demand, the requirement as stated for the model will include all the data. The requirement will be stated as follows: For 75.65% of the platforms, platform orientation will vary as much as $\pm 30^{o}$ from the local verticle. For 17.89% of the platforms, orientation will be random with no specific limits.

Allowable Platform Protrusions: The survey data for platform protrusions is given in Table 3.66 and Figure 3.16. The Response Factor was high (92%) indicating good data. As shown, 1.61% of the platforms require protrusions to be less than 6 inches from the body of the platform. Considering the combination of number of users and number of platforms, the demand for such protrusion constraints is low. This demand coupled with the fact of a rather severe constraint on antenna design leads to the conclusion that these users can be safely excluded from the model*. For purposes of the model then, the requirement will state that protrusions will vary with a minimum of 6 inches.

Platform Construction Characteristics: The survey data for platform construction characteristics is given in Figure 3.17. The Response Factor was high (97%) indicating good data. The demand, although not uniform, was not negligible for any of the three categories given. 64.51% of the users (82.18% of the platforms) desired rugged construction. 29.03% of the users (6.15% of the platforms) indicated that their platforms must be capable of withstanding everyday abuse. 11.29% of the users (11.64% of the platforms) indicated a need for frangible platforms. For purposes of the model, it is felt that, based on user demand, all three classes of construction should be considered. If pressure were to arise (e.g., for economic reasons) during the design of a system to eliminate one or two of the classes one would of course play percentages giving rugged construction a top priority.

The next major element in the data collection platform requirements model is the type of platform. The survey data for platform type is given in Table 3.67 and Figure 3.18. The Response Factor was high (98%) indicating good data. The data shows a large demand for Buoys and

---

* This also assumes that the platform is intended to transmit directly to the satellite.

Fixed Sites. The small demand for animal mounted platforms results from the fact that users interested in animal studies were considered in other studies and most of these users were excluded from the survey. The demand for balloons (3.22% of the users ~ 308 platforms) was very low relatively speaking. For the model then balloon mounted platforms will be included with a low priority. The remaining "other" types of platforms were of such low demand that they will be excluded from the model. Also animal mounted platforms will be excluded from the model because of low demand.

The next major element in the model is data collection platform reliability. The survey data relevent to platform reliability is the expected life of the platform. This data is given in Table 3.68 and Figure 3.19. The Response Factor was 100% indicating good data. For purposes of the model two categories for reliability can be used. A low reliability platform for up to one year of unattended operation and a high reliability platform for indefinite unattended operation. Note that the high reliability platform has more demand than the low reliability platform.

The final element of the data collection platform requirements model is platform cost. The survey data for platform cost is given in Table 3.69 and Figure 3.20. The Response Factor was moderate (86%) however, the data is considered to be reasonably representative. The data indicates that if $1,000 is used as a maximum for platform cost, most of the users would be satisfied and only a small percentage would be forced to compromise. Thus, $1,000 will be used in the model.

This completes the synthesis of the requirements model for a data collection platform based on the survey data. The model is summarized in Table 4.3 .

4.2.1.2 Data Collection System Requirements Model

Using Table 4.2 as a guide for the system requirements model, the first major element of the system requirements model is the System Communications Capability/Capacity. Note at the outset that certain of the items in this element were also part of the data collection platform requirements model. In fact the only item not included as part of the platform requirements are Platform Population vs Time and System Capacity. This being the case, those items previously discussed will not be duplicated in this section since their interpretation remains the same.

Number of Platforms per User: See Section 4.2.1.1.

Platform Population vs Time: Platform population as a function of time is plotted in Figures 3.24 thru 3.36. Figure 3.24 shows total platform population. The remaining plots show platform population for each

TABLE 4.3

DATA COLLECTION PLATFORM REQUIREMENTS MODEL

• Communications/Data Collection Capability:	
– Number of Platforms per User	Variable, 1 to 300
– Number of Sensors per Platform	8
– Decimal Precision of Data	2,3,4 Decimal Digits
– Analog Sensor Voltage Range	0 to 5 or −10 to +10v
– Digital Sensor Bits per Measurement	Variable, 4 to 48 Bits
– Synoptic Period	Variable, Continuous to 24 hours
– Bit Rate for Continuous Transmission	1000 BPS Maximum
– Is Platform Commandable/Interrogateable?	40% Yes
• Position Location Capability	
– Is Position Location of Platform Required?	20% Yes
• Environmental Conditions	
– Environmental Temperature Range	-100°F to $+100^{\circ}$F
– Other Environmental Conditions: Submersion in salt water, submersion in fresh water, high humidity, high winds, icing, heavy rains, heavy snow, snow loads, burial, vandal damage, (e.g., rifle shot), rodent damage, sustained low temperature, sustained high temperature, lightning, high altitude, dry/windy, high seas, rapid temperature change, rapid depth change, interfacing water currents, vibration and impact	
• Platform Physical Characteristics	
– Platform Weight (Maximum)	50% 1 Kg to 100 Kg 50% No Restriction
– Platform Size (Maximum)	Varies From Size of Grapefruit to No Restriction
– Platform Orientation Limits	75%: 0 to $\pm 30^{\circ}$ From Vertical 25%: Random

TABLE 4.3 (Cont)

– Allowable Platform Protrusions	6 inches (Minimum)
– Platform Construction Characteristics	3 Classes: Rugged (82%) Everyday Abuse (6%) Frangible (12%)
– Platform Type	3 Types: Buoy (43%) Fixed Site (47%) Balloon (10%)
• Platform Reliability	
– Expected Life of Platform	2 Classes: <1 Year (17%) Indefinite (83%)
• Platform Cost	
– User Cost Estimate (Maximum).	$1,000

geographic area defined by Figure 3.21. It was noted in Section III that the magnitude of the number of platforms (at anytime) is pessimistic because 16% of the 62 respondees did not give a specific value for number of platforms and were arbitrarily assigned zero platforms. This pessimism (or worst case) is amplified by the fact that the 62 respondees are only a portion of the total community of data collection users. In fact, as indicated in Section II, there are at least 262 organizations with a potential requirement for satellite data collection systems. Thus, the data in Section III is from approximately 24% of the total data collection user community; assuming 262 as the total user community. Thus one can safely say that the number of platforms will definitely exceed the numbers given in the plots*. The question then is: By how much will the "actual" number of platforms exceed the data? The answer to this question is dependent on how one infers the "actual" number of platforms from the data. One could use averages; that is derive an "average" value (Expected Value) for the number of platforms per user using Figure 3.1. This "average" value would then be multiplied by 200 to obtain a number for the additional platforms to be included as part of a projected "actual" value. One could also use percentiles. That is, select a particular percentile value from Figure 3.1 and multiply by 200. Another approach would be to assume that the remaining 200 users can be viewed as 3 groups of users each with a platform distribution approximating that given in Figure 3.1. The projected "actual" value using this approach is obtained by multiplying data values by 4. Using percentile values or expected values assigns a specific value to each user. It is felt that this is not a reasonable approach to projecting "actual" value for total number of platforms since it is more likely that the remaining users will have values distributed over a range of values. Thus the final approach discussed above will be used for this model.

To complete the model for number of platforms vs time it is necessary to make assumptions concerning the time of implementation, duration of operation, and geographic placement of the platforms. For the present model it will be assumed that the relative requirements among the remaining 200 users is identical to the percentages given in the data for these items. The model then is simply the plots in Figures 3.24 through 3.36 with all values for number of platforms multiplied by four (4).

An important characteristic of the model worthy of note is that requirements will evolve beginning in 1974 with 3000 platforms and reaching approximately 20,000 platforms by 1980.

<u>Number of Sensors per Platform</u>: See Section 4.2.1.1

<u>Decimal Precision of Data:</u> See Section 4.2.1.1

<u>Digital Sensor Bits per Measurement:</u> See Section 4.2.1.1

---

*An assumption throughout this report is that requirements stated by the respondees will indeed be implemented.

Synoptic Period: See Section 4.2.1.1

Bit Rate for Continuous Transmission: See Section 4.2.1.1

System Capacity: An important part of any communication system requirement is the capacity. That is the amount of data to be transferred by the system. Of major concern in a satellite data collection system is the amount of data to be transferred through the satellite which is acting as a relay between deployed data collection platforms and a data collection earth station. To derive a model for total throughput in bits, it was assumed that each platform had 8 sensors using 16 bits per sensor measurement. These values correspond to the platform requirements model derived in the previous section (see Table 4.3). Thus 128 bits of data will be transmitted by each platform once every synoptic period. Assuming a 50% efficiency in the platform data burst format, the total number of bits transmitted by each platform for each synoptic period (duration between samples) is 256. Realizing that platform synoptic period varies between continuous and 24 hours, one can plot the number of bits to be transferred vs time for a 24 hour period. This can be done for a worst case situation (maximum possible throughput) by assuming that all platforms with the same synoptic period requirement transmit at the same time and that all transmissions are synchronized to the same time reference for the start of a 24-hour period. Using the previously derived model for numbers of platforms and the relative distribution of platforms among the various synoptic periods given in Figures 3.6. Figure 4.2 gives throughput projections for 1974, 1977, and 1980 respectively. Note that the problem of the system designer is how to best transfer this data with a minimum power and bandwidth requirement.

Is Platform Commandable/Interrogateable?: See Section 4.2.1.1.

The next major element in the system requirements model is the Position Location Capability. The inclusion of such a capability obviously will affect the overall data collection system design. The way in which the design is influenced is dependent on how the position location is to be done which in turn depends on the position location requirements. A model for these position location requirements will now be derived using the questionnaire data as a basis.

Is Position Location Required?: See Section 4.2.1.1

Position Location Accuracy: The questionnaire data for position location accuracy is given in Table 3.73. The data indicates that approximately 45% of the users desire a position location capability. Of these users, the majority desire an accuracy between 1 kilometer and 5 kilometers. This range of values is within the state of the art for satellite position location systems. Since the demand for each of the specific values (i.e., 1, 2, and 5 km) is not negligible, the present model will state the requirements as 1 to 5 kilometers minimum accuracy.

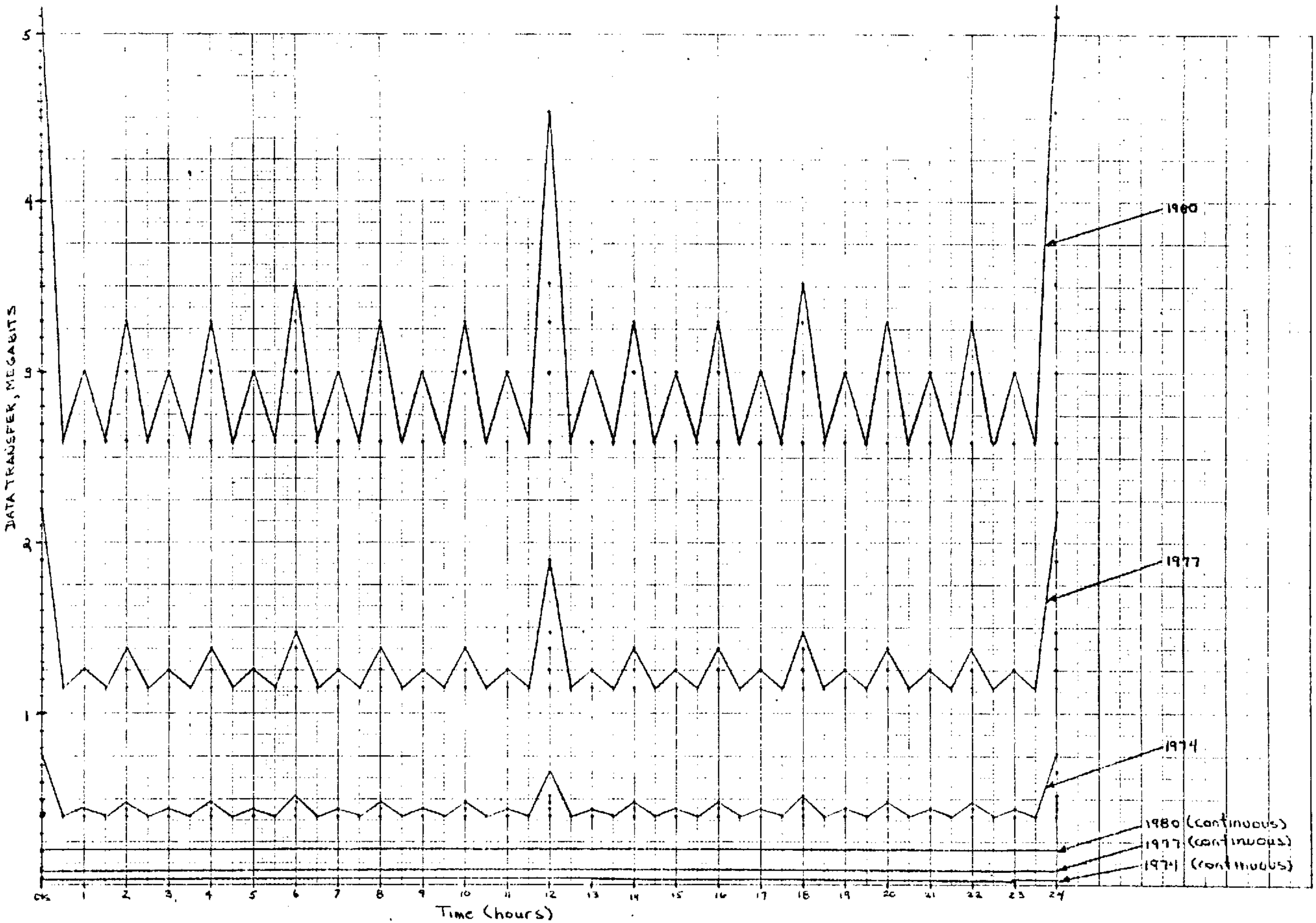

FIGURE 4.2. SATELLITE THROUGHPUT

Position Location Rate: The questionnaire data for position location rate is given in Table 3.74. As indicated, a very small percentage of the users require a rate less than one hour. Even though such rates are achievable (e.g., with a synchronous satellite), the present model will consider the demand for such rates as negligible. Thus , for the present model, the requirement for position location rate will be stated to be greater than or equal to (≥) one hour.

Position Location Data Delay: The questionnaire data for position location data delay is given in Table 3.75. The values given in the table are maximum allowable delays. Because a minimum position location rate of one hour has already been specified as part of the model, data delays below one hour are eliminated from the model. Since there is significant demand for all values greater than or equal to one hour, the model will state the requirement as being as low as one hour and as large as 24 hours. The "other" category will be ignored for present since all values in this category are greater than 24 hours and therefore a 24-hour delay will satisfy the requirement.

Platform Speed: The questionnaire data for platform speed is given in Table 3.76. The table shows that the response to all the stated values was non-negligible. Thus the requirement for platform speed will be stated as variable between 0 and 100 km/hr.*

Platform Acceleration Between Measurements: The questionnaire data for platform acceleration between measurements is given in Figure 3.41. The data shows a marked preference for random acceleration. The requirement will be so stated in the model.

The next major element in the system requirements model is the geographic disposition of the platforms. Such information is required at the outset of the design of satellite data collection systems since it determines the coverage required. The two items in this element for which data was obtained are Geographic Area vs Number of Platforms and Platform Density (Distance between Platforms).

Geographic Area vs Number of Platforms: The questionnaire data for geographic area vs number of platforms is summarized in Table 3.71. It should be kept in mind that platform population in each of the geographic areas is a function of time as shown in Figures 3.25 thru 3.36. The data shows an overwhelming preference for area D which includes the North American Continent and its coastal waters. Also the remaining areas all have a non-neglible interest. Thus, even though area D is overwhelmingly preferred the other areas cannot be ignored. The requirement for coverage will then be stated as Global in the present model.

Distance Between Platforms: The questionnaire data for distance between platforms is summarized in Table 3.72. The Table shows very little interest for separations greater than 1000 km. Thus this value will

* This range of values obviously eliminates aircraft from the model.

be discarded from the model. If a range of values between 10 and 100 km is used a significant majority of the users will be included. Thus this range will be used in the requirements model. Any reduction in this range would eliminate a significant number of users.

The next major element of the system requirements model is time. That is requirements are always a function of time. The intent of this portion of the model is to specify basic time information. The data available from the questionnaires is Time of Implementation and Duration of Operation. Incidentally this basic information was used to obtain the platform population curves in Figures 3.24 thru 3.36.

Time of Implementation: The questionnaire data for time of implementation is given in Figure 3.23. The data shows significant demand for each of the three years stated. The data also shows an increase in demand with time indicating an evolving requirement as one would expect. For the present requirements model, implementation will be stated as beginning in 1974 and continuing through 1980 with the number of platforms increasing with time (Figures 3.24 thru 3.36).

Duration of Operation: The questionnaire data for duration of operation (or Expected Platform Life) is summarized in Table 3.68. As shown in the Table, values for duration of operation vary from 3 months to indefinite with a definite preference for longer periods. Note that this data in conjunction with the time of implementation data was used to generate the platform population vs time curves in Figures 3.24 thru 3.36). Since none of the requirements stated by the users are non-negligible, the requirements for the present model will be stated as being variable between 3 months and indefinite with an indefinite period (>5 years) as most likely.

The final element of the system requirements model is Data Dissemination. A major problem associated with a satellite data collection system is the dissemination of sensor data (collected via satellite) to the users. How this is done will depend heavily on the users requirement. His requirement may vary from real-time to weekly or monthly. In any event, the faster he requires his data, the more sophisticated will be the communications subsystem for data dissemination. The data to be forwarded to the users (or experimenters) will consist of sensor (DCP) data and position location data. The tolerable delay in receipt of this data was included in the survey.

DCP Data Delay: The questionnaire data for DCP data delay is summarized in Table 3.77. As with the other system data their is a distribution of data delay values with varying demands. For the present model the "other" categories will be ignored. Having done this, the table shows two distinct classes of data delay. These are "under 24 hours" and "more than 24 hours". The former class would require the use of an electronic communications system. The latter class could be handled by mail or similar services. Note that once a communications link is established between the user and the data, the delay could be any value if proper communications coordination and control is used. For purposes of the present model DCP data delay will be stated as being variable within the two classes mentioned.

Position Location Data Delay: See page 4-16.

This completes the synthesis of the requirements model for data collection systems based on the demand shown in the survey data. The model is summarized in Table 4.4.

4.2.2 Requirements Based on User Mission

To view the requirements data from another perspective, user requirements data was tabulated according to area of interest as shown in Section 3.2, (e.g., Table 3.17). If the user indicated an interest in a particular area, his data was tabulated under this area (e.g., Table 3.17). Although this procedure appears straightforward, it is complicated by the fact that most users checked more than one area of interest.

The original intent of the study was to further refine the requirements data as it relates to various areas of interest. This refinement would have consisted of recontacting users who specified more than one area of interest to determine why he checked more than one area of interest and to which of the multiple areas checked his data applies. Also, the problem of definition of areas of interest would have been discussed to ensure an agreement existed. The net result of this effort would have been the addition or deletion of user data from the various tables. Unfortunately, time and funds did not allow for the pursuit of this effort since the respondees are widely dispersed geographically.

Even though this refinement was not possible, it is still possible to reach some general conclusions on the requirements as they relate to areas of interest. First of all, the data was examined for inconsistencies and none were definitive enough to be pursued. Next, it is apparent upon examination of the data that in each area of interest the requirements are mixed. Thus any attempt to make the requirements more definitive than the tables in Section III (e.g., Table 3.17) would result only in a summary of the tables. Thus the tables in section III constitute the requirements models for the various areas of interest.

4.3 RELATIONSHIP BETWEEN USER MISSIONS AND EXISTING OR PLANNED PROGRAMS

Table 4.4 gives a listing of existing and planned NASA satellites and their anticipated period of operation. The figure shows that both polar orbiting and synchronous satellites will be operational in the 1974 to 1980 time frame. Also there is considerable overlap in the operational periods of these satellites.

TABLE 4.4

DATA COLLECTION SYSTEM REQUIREMENTS MODEL

• Communications Capability/Capacity:	
– Number of Platforms per User	Variable, 1 to 300
– Platform Population vs Time	Multiply Figures 3.24 thru 3.36 by 4
– Number of Sensors per Platform	8
– Decimal Precision of Data	2,3,4 Decimal Digits
– Digital Sensor Bits per Measurement	Variable, 4 to 48 Bits
– Synoptic Period	Variable, Continuous to 24 hours
– Bit Rate for Continuous Transmission	1000 BPS Maximum
– System Capacity	Figure 4.2
• Position Location Capability:	
– Is Position Location of the Platform Required?	20% Yes
– Position Location Accuracy	1 to 5 Kilometers
– Position Location Rate	≥ 1 hour
– Position Location Data Delay	1 to 24 hours
– Platform Speed	0 to 100 km/hr
– Platform Acceleration Between Measurements	Random
• Geographic Disposition of Platforms:	
– Geographic Area vs Number of Platforms	Global Coverage Required with High Preference for North American Continental area
– Distance Between Platforms	10 to 100 Kilometers

TABLE 4.4 (Cont)

• Time Frame:	
– Time of Implementation	1974 thru 1980
– Duration of Operation	Variable, 3 months to indefinite
• Data Dissemination	
– DCP Data Delay	Variable within two classes: > 24 hours, < 24 hours
– Position Location Data Delay	1 to 24 hours

Since these satellites are planned, the question then is whether or not they can be used as the space segment of a data collection system to satisfy the user requirements indicated by the survey. Speaking in a technical sense, the answer is yes. These satellites could provide the coverage, communications capacity, and position location capability required to satisfy a significant majority of the requirements thru 1980. There might be some compromise of particular user requirements because of implementation and scheduling problems but in general it is technically possible to use these satellites.

With the existence of the satellites shown in Figure 4.3 , the real problem becomes one of coordination and priorities. That is a communications repeater for data collection could be added to the spacecraft configuration if it was desired to do so and this additional equipment would be minimal*. Also, if desired, any of the satellites could form the space segment of a position location system. The only requirements that might be ruled out by these satellites are certain coverage/synoptic period combinations. For example synoptic periods of one hour cannot be achieved with polar orbits since there orbit periods are approximately 90 minutes. The synchronous satellites could, however, handle most of the shorter synoptic periods (< 90 minutes). The problem of coordination is obvious in this case.

4.4 NEW TECHNOLOGY REQUIREMENTS

The survey questionnaire data revealed requirements that would necessitate new technology (or advanced technology) in the following areas:

- Data Collection Platform Weight
- Data Collection Platform Size
- Data Collection Platform Protrusions
- Data Collection Platform Cost.

4.4.1 Data Collection Platform Weight

As shown in Table 3.63, a significant number of users desire data collection platform** weight of 1 kilogram (2.2 pounds) or less. Experience has shown that 1 kilogram is a reasonable weight for the electronics portion of a platform and in fact the weight of the electronics has been as low as .5 kilograms. However, the combination of battery weight and the weight of materials required for packaging to meet various environmental conditions increase the weight of the platform approximately ten-fold. Thus to achieve platform weights of even 5 kilograms or less new technology is required. Specifically lighter weight batteries are required, lighter packaging materials and light weight antennas are required.

---

* It is important to note that the requirements data indicates that a communications channel capable of approximately 3 kilobits per second would be more than adequate for non-continuous data collection.

**The term "platform" is defined here as all on-site equipment exclusive of sensor and mounting apparatus.

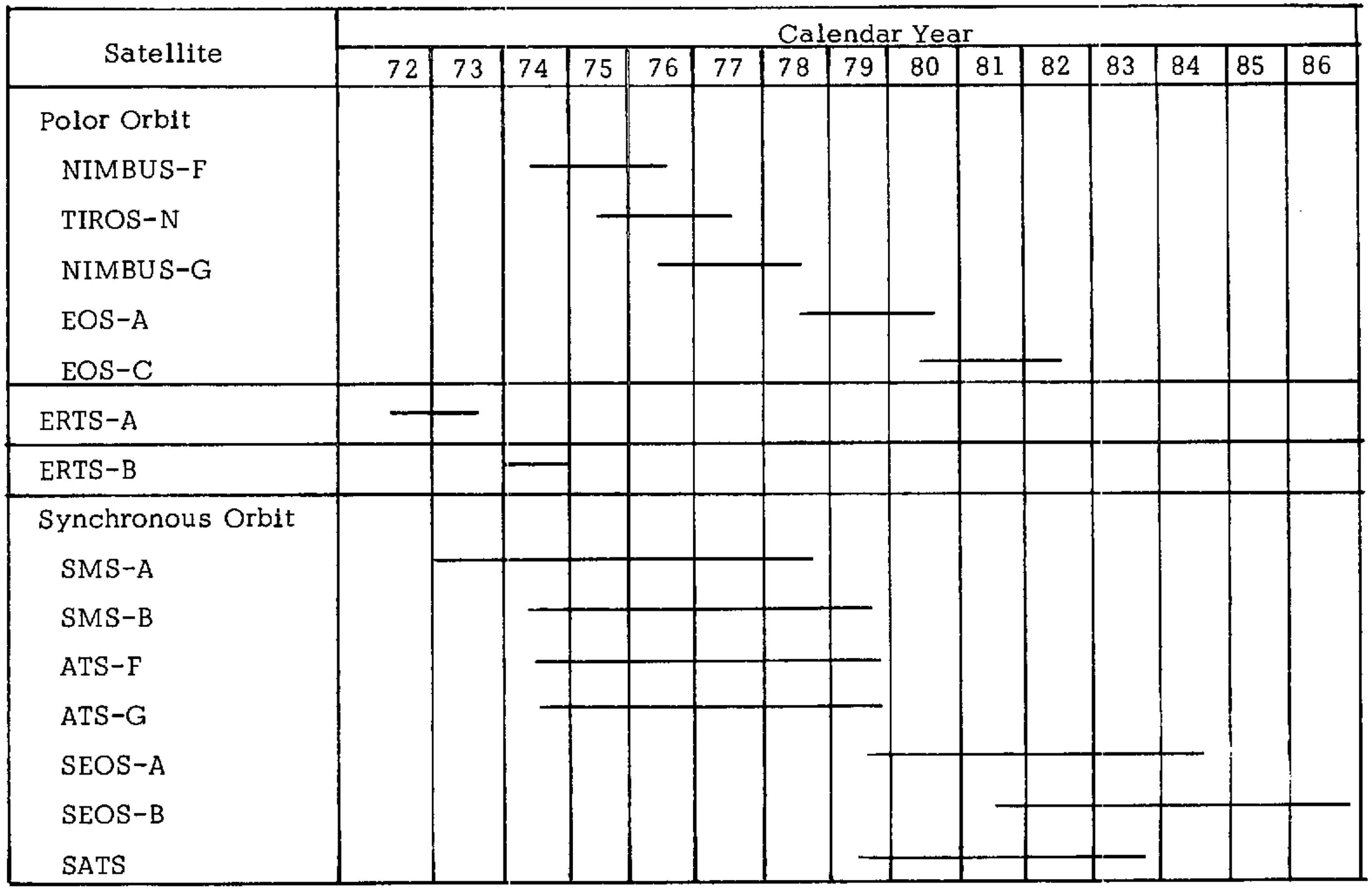

FIGURE 4.3. NASA SATELLITE PROGRAMS

4.4.2 Data Collection Platform Size

As shown in Table 3.64, a significant number of users desire rather small platforms. With regard to platform size, one should realize at the outset that platform size is dependent on the functional requirements of the platforms as well as platform configuration*. For example, if the platform is to be interrogated, a receiver is required; thereby increasing the number of components required. Also if platforms were configured to transmit data to another larger platform which transmits to the satellite, platform size could be reduced.

Platform size is also a function of component size. The components of a platform can be grouped as follows:

- Electronics
- Prime Power
- Packaging
- Antenna.

Components associated with each of these areas must be accounted for when considering overall platform size.

Thus, when one considers some of the platform sizes desired by the the users (e.g., smaller than an orange) it is apparent that a new small-platform technology is required. This small-platform technology will involve new concepts for platform configurations as well as new concepts (or technology) in platform electronics, prime power, packaging, and antennas. More specifically, this new technology will consist of the use of Large Scale Integration (LSI) of the electronic circuits thereby reducing the space occupied by electronic circuitry. Further, this new technology should result in smaller batteries, smaller antennas, and advanced packaging and environmental control techniques.

In attempting to develop this new technology many problems will have to be overcome. These include:

- The provision of adequate transmitter power
- The provision of adequate prime power
- The provision of adequate antenna gain
- The provision of adequate environmental control.

---

*The same is true for platform weight.

4.4.3 Data Collection Platform Protrusions

As shown in Table 3.66, a significant number of users desire platform protrusions to be less than six inches or nonexistent. This is a rather severe requirement to be placed on the platform antenna. An obvious immediate solution would be to increase transmitter power in proportion to the decrease in antenna size. However, increasing transmitter power will in all likelihood increase the overall size of the platform which may also be unacceptable to the user. Another solution might be the use of higher frequencies with their proportionate decrease in antenna size for a given gain. However, this approach has system implications (frequency of operation) which may or may not be acceptable. Another approach might be the use of an intermediate platform which transmits to the satellite thereby allowing the smaller platform to have less transmit EIRP.

Thus, if platforms with such small protrusions are to be implemented investigations involving many considerations, including those mentioned above, must be carried out to provide the desired capability.

4.4.4 Data Collection Platform Cost

As shown in Table 3.69, user desires for platform costs are rather mixed. Acceptable costs range from 100 dollars to 5000 dollars for most of the users queried.

Rather than stating a specific bogie for platform cost as a new technology goal, it is probably more meaningful to state reduced platform costs as a continuing goal and that costs should be reduced wherever and whenever possible. Absolute costs are invariably difficult to determine; however, cost reduction techniques are not so difficult to identify.

4.5 SATISFYING USER REQUIREMENTS BY MEANS OTHER THAN SATELLITE

The major reason that satellites are used as part of a data collection system is that the satellite can provide coverage over very large geographic areas making possible communications links between widely separated points. For example, a satellite in a polar orbit can provide global coverage (not continuous) thereby permitting communications with data collection platforms all over the earth. Also, a synchronous satellite can provide continuous coverage over an area of approximately 95 million square miles. In terms of data collection systems, this coverage is beneficial for the following reasons:

- Data Collection Platforms can be placed in remote areas such as the arctic regions and the oceans without the provision of special terrestrial communications links. In fact, once the satellite coverage is established, the problem of establishing a communications link between the data collection platform and the satellite is relatively independent of the location of the platform. This eases the deployment problem.

- Large numbers of widely dispersed platforms can be handled easily by satellite. Thus a satellite data collection system can be viewed as an integrated system dedicated to the data collection function. Such a large scale dedicated system would be difficult to implement using terrestrial facilities. It is not difficult to understand this fact if one considers the interface problems that would be encountered, the operating personnel required (e.g., ship personnel for a ship acting as a node in an oceanographic data collection system, the equipment maintenance problems, and the general non-homogeneity that would result if such a system were implemented with terrestrial facilities. Also costs of such a system would probably exceed that of a satellite system.
- Long Distance Communications links can be provided with high reliability. A satellite link contains significantly less cascaded equipment than an equivalent terrestrial link.
- Data Collection Platforms which are continuously in motion (e.g., balloons and buoys) do not require special treatment. Such platforms can move anywhere within the satellite coverage, at any velocity with no effect on their ability to transmit data. Significant too is the fact that special operational control procedures are not required (e.g., handover to different relay stations).

Another benefit gained by using satellites is the ability to provide platform position data very accurately.

If data collection systems were to be implemented using terrestrial communications facilities, these systems could efficiently perform only for certain types of requirements. In fact, one can conclude from the preceding discussion that such systems are best suited for systems involving small numbers of platforms which are neither widely dispersed or remotely located. That is, all the data required by an experimenter can be collected within a relatively small area. The exact break point between small area terrestrial systems and large area satellite systems would depend on many factors and could be derived only through detailed and extensive studies. Also, experiments of short duration would probably be better handled by terrestrial means (if satellites are not already available). Long duration experiments could become expensive considering the costs of dedicated communication circuits over long periods of time (e.g. years)*.

The questionnaire data indicated that approximately 32% of the users would deploy data collection platforms in more than one of the defined geographic areas (see Figure 3.21). Another 16% of the users indicated one geographic area with a separation between data collection platforms of more than 100 kilometers. It is apparent then that a significant portion of the users require the coverage provided by satellites. The questionnaire data also indicated that about 10% of the users required experiments to last less than a year. Thus a significant portion of the users have long term requirements which can be better satisfied using a satellite system. In general then a significant portion of the data collection community have requirements best satisfied using a satellite system.

In closing, it should be noted that the viability of collecting data by satellite is highly dependent on the availability of satellites. The previous section shows that NASA will be providing a significant number of satellites in the near future (10 years). Also, with the advent of domestic satellites, channels would be available (by leasing) for continental U.S. coverage. Further the Intelsat system now in existance could provide global coverage. Both the Domestic satellites and the Intelsat satellites could form the space segment of operational rather than experimental data collection systems.

---

*A satellite system by definition has a lifetime in years.

REFERENCES

1. "Study of Data Collection Platform Concepts", Phase 1, Task 1 and 2, Report. Contract No. NAS5-21632, June 1972.

2. "Study of Data Collection Platform Concepts - Computer Processing of Survey Data", Phase 1, Task 4 Report, Contract No. NAS5-21632, October 1972.

APPENDIX A

EXAMPLE DATA TABULATIONS

A.1 INTRODUCTION

In this appendix, a hypothetical user population answering a hypothetical question in various ways will be presented. The intent is to clarify the effect of the idiosyncracies of the data from the questionnaires. More specifically, hypothetical user response to the hypothetical question will be presented in the same manner that it is presented in the text of this report. In this way the effect of the data idiosyncracies can be clearly demonstrated.

A.2 DISCUSSION

The hypothetical user population will consist of 10 respondees (or users). This means that the data base for this example would consist of ten questionnaires. The hypothetical users are listed in Table A.1 along with their associated number of platforms. Of significance in Table A.1 is the fact that not all the users indicated a specific number of platforms and were arbitrarily assigned zero platforms.

A hypothetical question will now be considered which is similar to the questions given in the questionnaire. The question will have four possible numbers (A, B, C, and D). Three different ways in which the question could be answered by the hypothetical users will now be presented. Also, the data from these answers will be tabulated in the same way that it is tabulated in the main body of the report.

TABLE A.1

HYPOTHETICAL USER POPULATION

User ID	Number of Platforms
a	20
b	20
c	20
d	20
e	20
f	0
g	0
h	0
i	0
j	0

A.3 HYPOTHETICAL DATA

A.3.1 First Example

The first example will assume that the hypothetical users responded to the hypothetical question as shown in Table A.2.

TABLE A.2

HYPOTHETICAL USER RESPONSE - FIRST EXAMPLE

Possible Answers to Question	Respondees Who Indicated Answers
A	a,b,h
B	g,i
C	c,d
D	f,c

Table A.2 shows that, for example, users (or respondees) "a", "b", and "h" selected answer "A" of the question. Note in the table that user "c" selected two answers (this occurred frequently in the real questionnaire). Also note that only eight of the ten possible users answered the question. This too frequently occurred in the real questionnaire. Since only eight users answered the question, the Response Factor, as defined in the main body of the report, would be 8/10 or 80%. The bar graph specifying the results of this question is given in Figure A.1. Notice in the Figure that for answer A (as an example) three (3) users selected answer A and only two (2) of these three specified a number of platforms. The numbers in parenthesis above the bar are meant to indicate this (i.e., (3/2)).

The second way in which the results of each question are presented is in the form of a percentage table. These tables are given throughout Section 3.3. The percentage table for the first example is given as Table A.3. Notice first of all in the table that the percentages in the "% users" column do not add up to 100% nor does the sum of these percentages equal the Response Factor. The reader is therefore discouraged from attempting to find meaning in this sum. The only conclusion from the "% users" column should be that 30% of the users selected "A", 20% selected "B" and so on. The same is true for the "% platform" column.

TABLE A.3

PERCENTAGE TABLE FOR FIRST EXAMPLE

Hypothetical Answers	% Users	% Platforms
A	30	40
B	20	0
C	20	40
D	20	10

By way of illustration, two more examples will be given to show that the sums of the percentages in these columns will vary according to the way in which the user population responds to the question. That is the "% users" column in the example just presented summed to less than 100%. In the following examples it will add to both a number greater than 100% and equal to 100%.

A.3.2 Second Example

For this example, the hypothetical user population is assumed to respond to the question as shown in Table A.4.

TABLE A.4

HYPOTHETICAL USER RESPONSE - SECOND EXAMPLE

Possible Answers to Question	Respondees Who Indicated Answers
A	a,b,c
B	d,i,c
C	e,f,g
D	h,i,j

The bar graph corresponding to this user response is shown in Figure A.2. The percentage table is given as Table A.5.

TABLE A.5

PERCENTAGE TABLE FOR SECOND EXAMPLE

Hypothetical Answer	% Users	% Platforms
A	30	50
B	30	30
C	30	20
D	30	0

A.3.3 Third Example

For this example, the hypothetical user population is assumed to respond to the question as shown in Table A.6.

TABLE A.6

HYPOTHETICAL USER RESPONSE - THIRD EXAMPLE

Possible Answers to Question	Respondees Who Indicated Answers
A	a,b,c
B	d,i
C	e,f,g
D	h,j

The bar graph corresponding to this user response is shown in Figure A.3. The percentage table is given as Table A.7.

TABLE A.7

PERCENTAGE TABLE FOR THIRD EXAMPLE

Hypothetical Answer	% Users	% Platforms
A	30	60
B	20	20
C	30	20
D	20	0

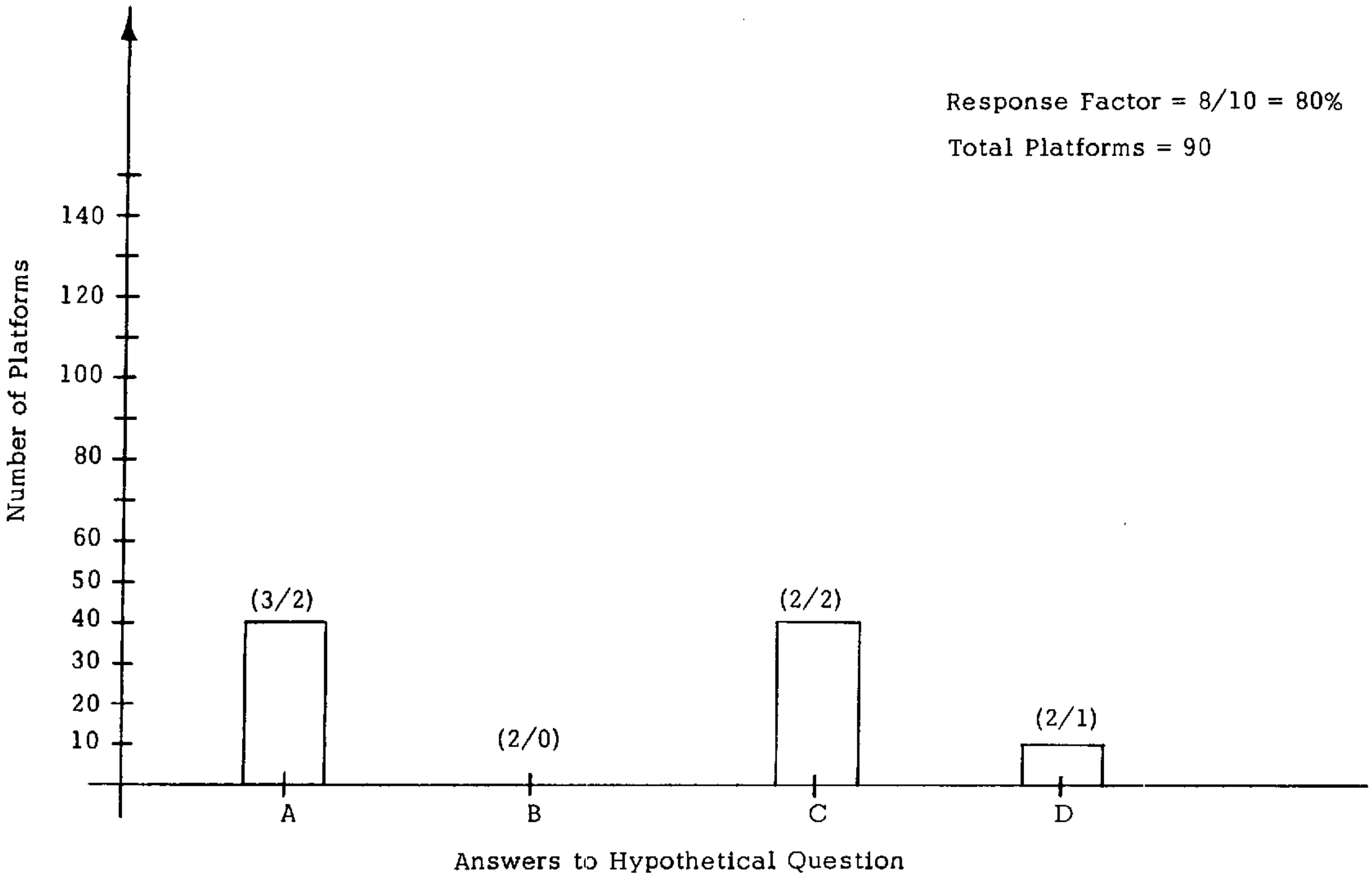

FIGURE A.1. BAR GRAPH FOR FIRST EXAMPLE

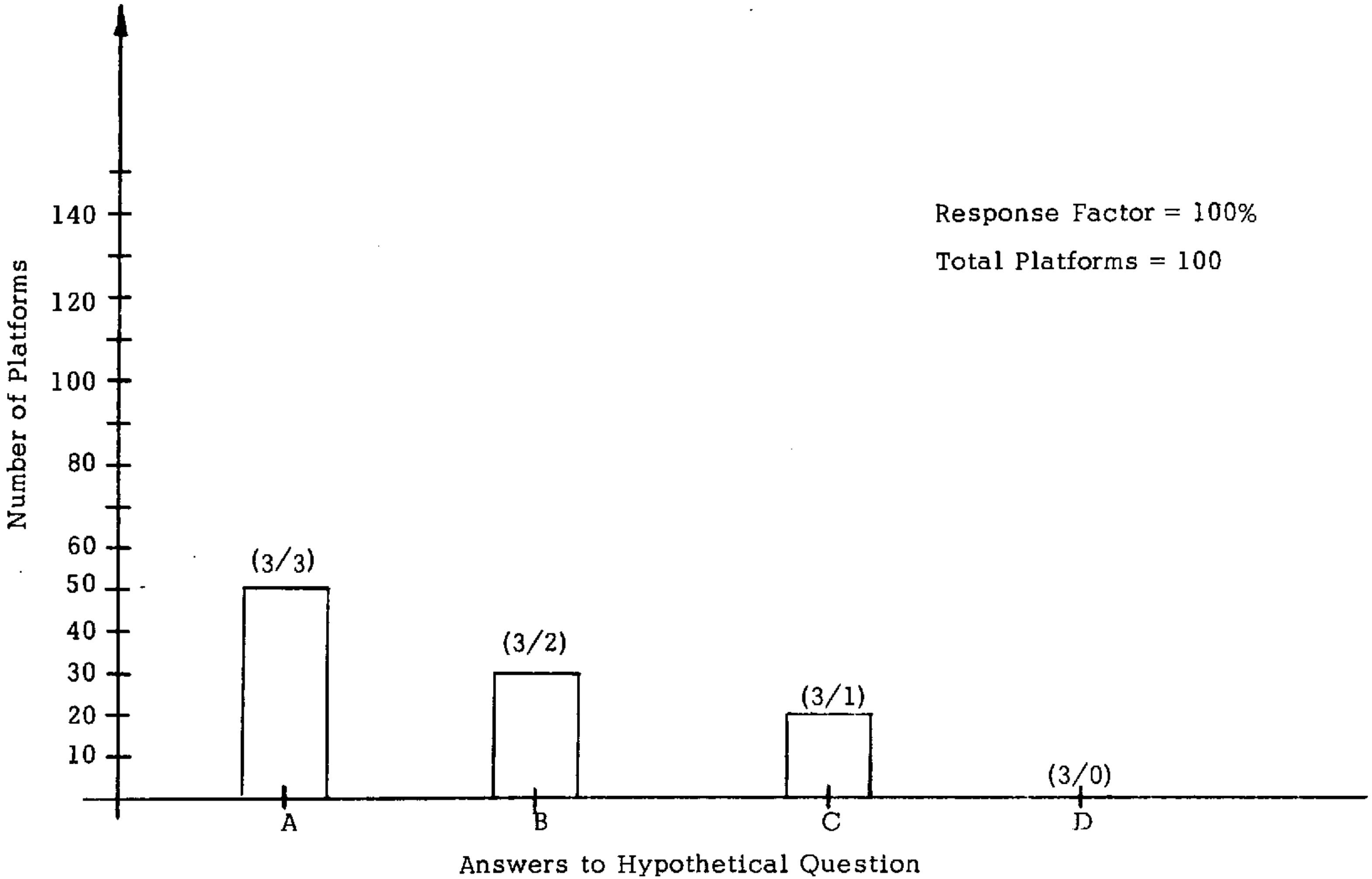

FIGURE A.2. BAR GRAPH FOR SECOND EXAMPLE

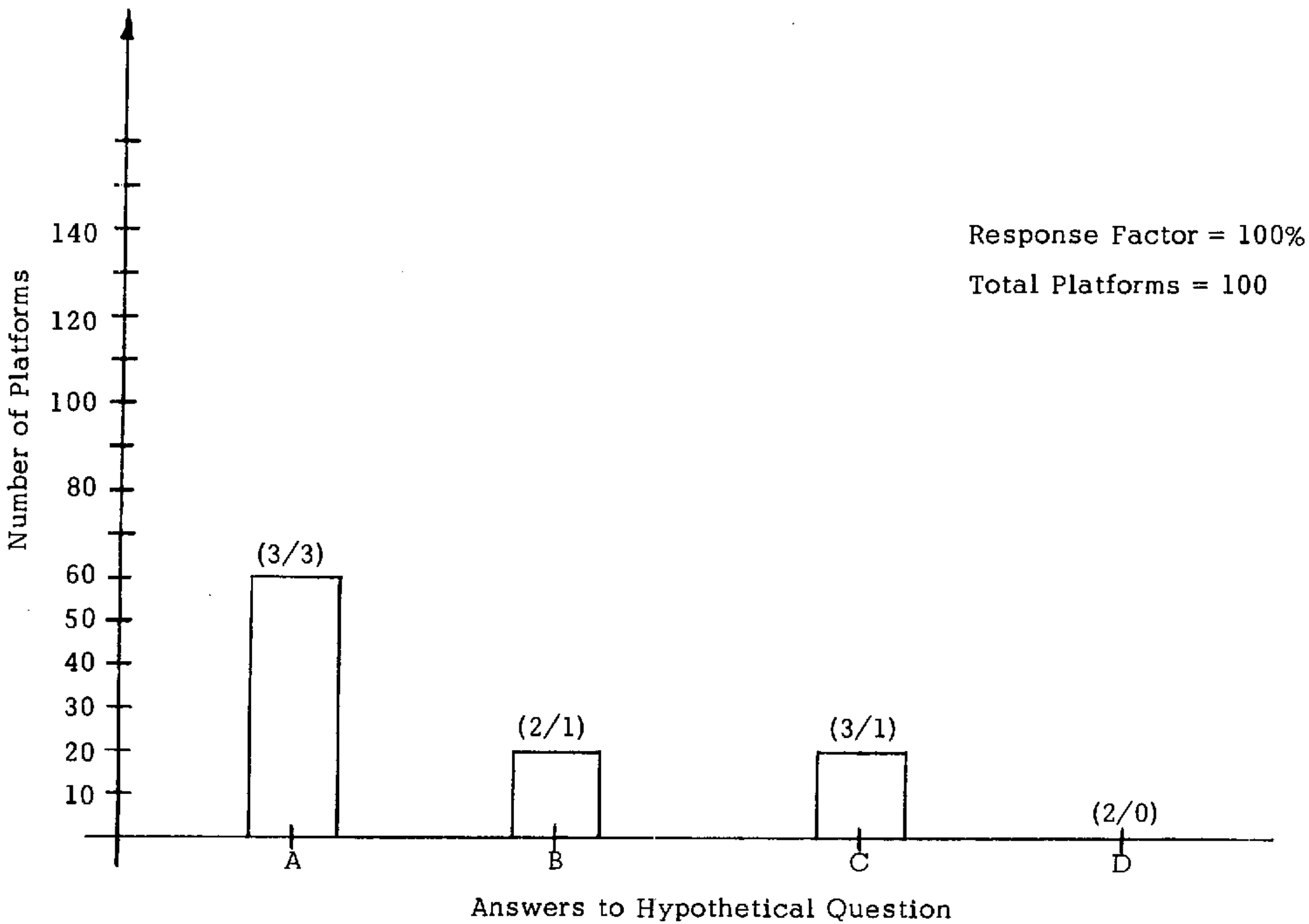

FIGURE A.3. BAR GRAPH FOR THIRD EXAMPLE